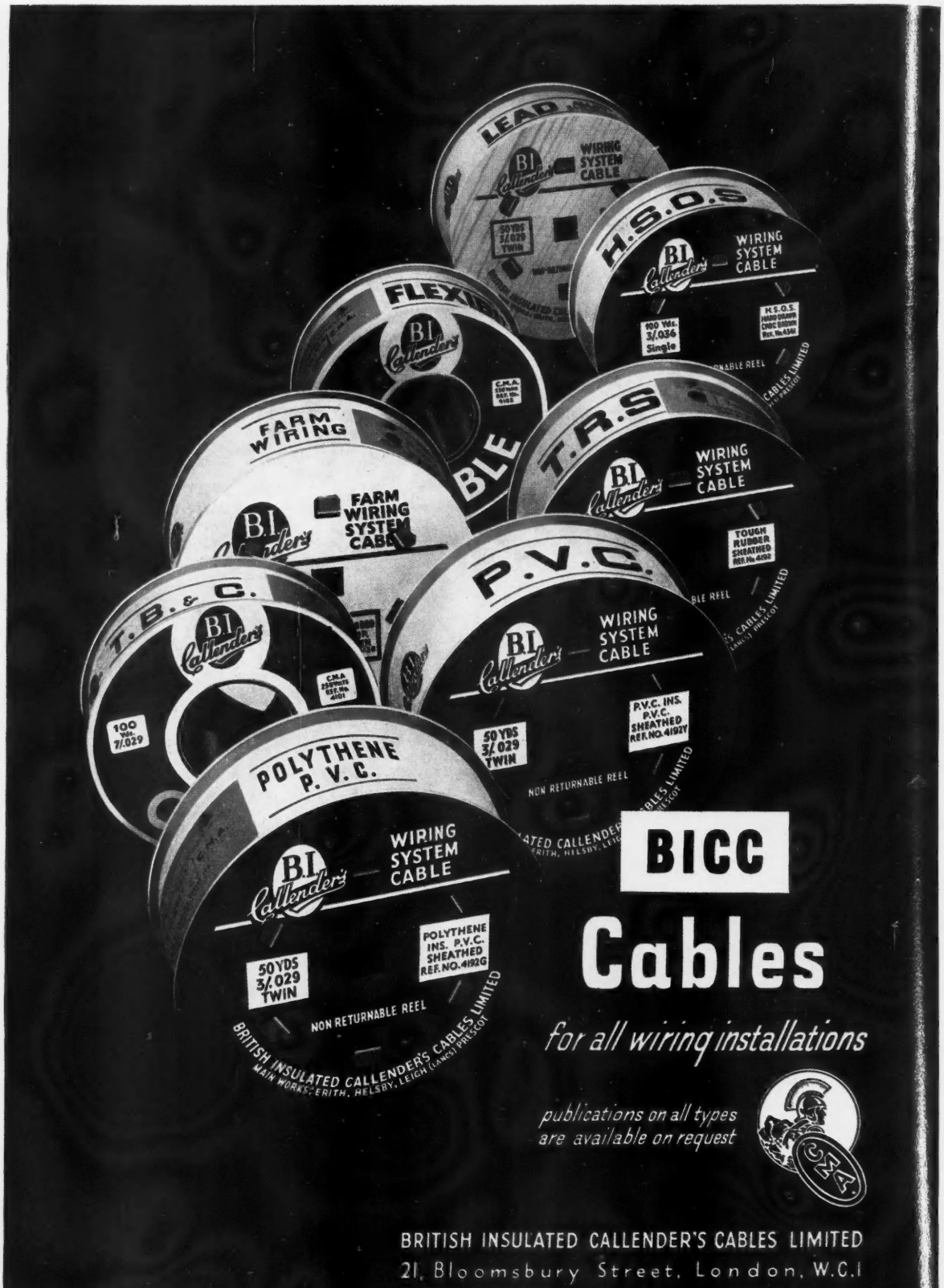
ELECTRICAL REVIEW

IN THE FOREFRONT OF • ATOMIC DEVELOPMENT

G. E. C.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ELECTRICAL REVIEW

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2 DECEMBER 1955

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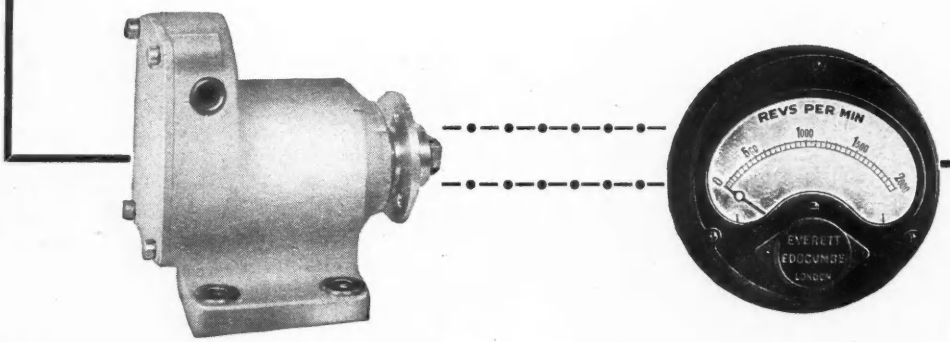
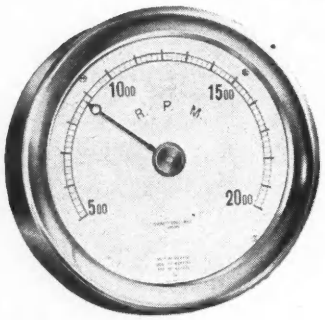
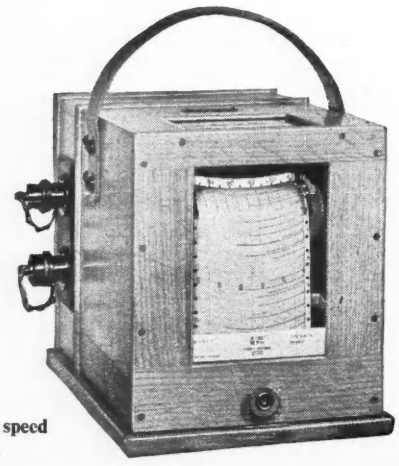


Typical speed transmitter for floor or bracket mounting.



Disc scale indicating speedmeter.



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ELECTRICAL REVIEW

2 December 1955 Vol. 157 No. 23 Established 1872

Railway Traction

THE Plan for the Modernization and Re-equipment of British Railways published last January visualized diesel traction as "a half-way house to electrification" and it was said that by the end of the period covered by the Plan (fifteen years) about 2,500 main-line diesel locomotives should be in use; the total expenditure on these was put at £125 million. Last week's announcement by the British Transport Commission that 141 main-line locomotives and 30 power units had been ordered therefore represents the small start of a large programme.

Forms of diesel traction were not discussed in the Plan and it is gratifying to see that this first order consists mainly of diesel-electric locomotives. The work is to be spread over a number of electrical manufacturing companies as will be seen from the details given in this issue.

Nevertheless it must be reiterated that diesel traction is destined eventually to give place to electrification. The Plan admitted that "in many ways electricity is ideal since it meets the requirements of reliability, good acceleration, cleanliness and (where the traffic is sufficiently heavy) economy in operation." It was the qualification in the last item upon which the Commission based its decision to employ diesel traction in the first stage. The idea was to build up traffic to a density which the Commission considered to justify main-line electrification but its views on this matter were challenged in the *Electrical Review* (29th January) at the time of the Plan's appearance.

The 1951 Committee on Railway Electrification, of which Mr. C. M. Cock was chairman, considered that at least half of the lines in this country could be profitably electrified. In our Railway Electrification Issue of 21st May, 1954, Mr. W. B. Noddings estimated that traffic density on about a fifth of the main lines (4,000 route miles) was already high enough to warrant electrification.

Therefore our satisfaction that electric traction in some form is being proceeded with is tempered by our belief that full electrification is the better way. Of course the Commission's present policy is not necessarily unalterable. Indeed it was stated in the Plan that if it should subsequently decide that it was practicable to electrify a section upon which diesel traction had already been introduced the diesel units would be used elsewhere. While this was no doubt an honest statement it was somewhat qualified by the consideration that because of the volume of civil and signal engineering involved there was a limit to the amount of main-line electrification that it appeared practicable to complete within the period of the plan, and that amount of work (£120 million) had been provided for.

ENCOURAGING EXPORT TRADE

In the recent House of Commons debate on export trade Sir Charles Taylor called attention to Great Britain's falling share of world export trade and the growth in the German share. He urged the Government to give more active encouragement to British exporting industries particularly by way of tax adjustment in respect of export revenue. Although this sounds feasible it must be remembered that we have just succeeded in persuading Germany to drop a similar scheme, as Mr. A. R. W. Low, Minister of State, Board of Trade, mentioned at the recent B.E.A.M.A. dinner. We cannot subsidize exports while discountenancing this practice on the part of our trade rivals. What the Government can do is to create a favourable " atmosphere " for exporters to work in, which means, among other things, that more discrimination should be shown in moves to curtail home sales and continued watch kept for any attempts by other Governments to impose unwarrantable restrictions upon imports. At the same time it can continue and strengthen the services which it renders to exporters, particularly those of the Export Credits Guarantee Department.

SENSE OF RESPONSIBILITY

The need for electrical engineers to play their full part in what has been termed the " second industrial revolution," arising out of the application of nuclear energy to electricity generation, was an underlying theme of speeches at the annual dinner of the Electrical Power Engineers' Association reported in this issue. Technological and administrative attainments of an increasingly high order will be called for not only in regard to power station aspects but also in the consequently much extended spheres of transmission, distribution and application of electricity. Members of an organization which, in addition to safeguarding their legitimate interests, has taken as its leading aim the good of the industry and, by implication, of the public it serves may be trusted to accept the responsibility of preparing themselves for a future that offers so exciting a technical prospect. A further and more material incentive is the greatly widened scope that will be offered to men having the required qualifications.

OVERHEAD LINE ERECTION

Overhead line erection, purely as such, comes into the news much less often than do other forms of electrical construction, probably because of the continuity of the work. There are not so many clearly defined stages of development as there are in the case of, say, a power station where the commissioning of the various components marks stages in the work carried out in one place from beginning to end. This does not mean, however, that the technique of overhead line erection is less progressive in any way, a fact which is made abundantly clear by Mr. G. R. McCullagh in his article in this issue, which has particular reference to the construction of the new 275 kV supergrid in this country. His story covers the work from surveying the site or route to establishing the tower foundations, erecting the tower sections, transporting, laying out and lifting the conductors and insulators, and tensioning the conductors—all employing modern materials handling methods and equipment. It is a stimulating account of work which calls for foresight, good judgment, skill and hard work.

ELECTRIFICATION OF MINES

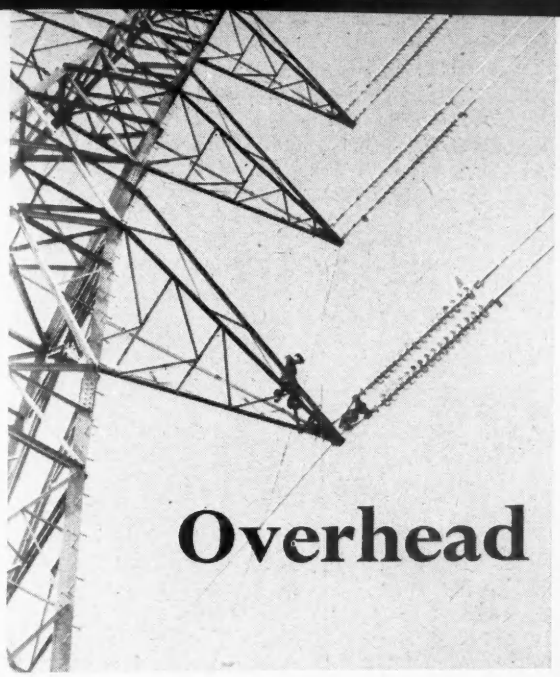
This year's Faraday Lecture was particularly timely in view of the widely expressed disappointment with the results, as measured by coal output, of the large scale mechanization of mines that has been undertaken. Mr. B. L. Metcalf indicated the engineering difficulties to be faced in reconciling the immediate need for raising output, while avoiding disturbance to production, with the equally important need of modernization in the interests of the future. He left no doubt in the minds of his audience that only thorough-going electrification would serve. Probably the most important, as it is the most obvious, obstacle is provided by the changeover from steam winders which, though generally inadequate for modern requirements, cannot easily be taken out of use for replacement.

ELECTRICAL ACCIDENTS

The report for 1953 of H.M. Principal Electrical Inspector of Mines, which is reviewed in this issue, indicates that the total number of persons involved in electrical accidents in the mining industry—67 fatal and non-fatal—expressed as a percentage of the total h.p. of motor capacity in use (3,445,383 h.p.) is almost the same as the corresponding figure for 1952. The total number of persons involved in electrical accidents in 1952 was 62 and the total h.p. of the motors in use was 3,326,539. We are confident that nobody concerned in this matter will be completely satisfied until the number of electrical accidents is very drastically reduced. Nevertheless, considerable satisfaction can be obtained by comparing the electrical accident position in the mining industry to-day with what it has been in the past, and with accidents in various other industrial fields, a reduction which has been achieved only by the adoption of exacting techniques to bring about safety in mining.

NO SCOPE

The House of Commons Select Committee appointed to examine the affairs of the nationalized industries has come to the conclusion that the severe limitations placed upon it in the order of reference leaves nothing that it can usefully deal with. This is not surprising when the terms of the order are examined together with the statements made by or on behalf of the responsible Ministers. The Committee could not investigate subjects which were clearly the province of the Ministers and how wide that province is can be seen from the statements in the report. Nor could it touch upon wages or conditions or matters of day-to-day administration. The Committee of Inquiry into the Electricity Supply Industry under the chairmanship of Sir Edwin Herbert, which is expected to produce its report before the end of the year, was not so inhibited. Judging from the list of organizations from which it has been taking evidence and from the statements of evidence published by some of them every aspect of the supply industry's organization and operation has been examined.



Building of the Supergrid Means Developing Modern Construction Techniques

By G. R. McCULLAGH, B.Sc., M.I.E.E.*

Overhead Line Erection

Pair of conductors going up to the cross-arm after cutting to length

SINCE Mr. J. L. Eve's address to the Institution of Electrical Engineers in 1938 on "Progress in Overhead Transmission Lines" great changes have taken place in design. The most significant of these was caused by the decision to erect a supergrid working at an ultimate voltage of 380 kV with lines capable of carrying nine times more load than those of the original 132 kV system.

The special problems met in the construction of these supergrid lines arise firstly because of the increase in the size of the structures and conductors, and, secondly, because the much higher transmitting voltage requires twin conductors to keep down corona discharge losses, reduce radio and television interference, and reduce the line reactance. A standard-height straight line tower, with approximate dimensions, is shown in Fig. 1.

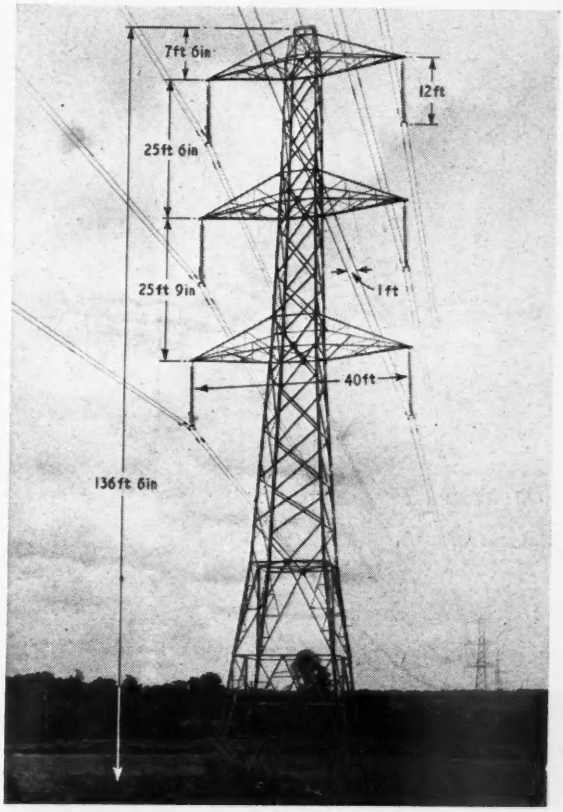
In the early days it was not always thought necessary to make a profile of a route to decide structure positions and heights. It was not a very expensive matter to put in an extra wood pole if someone "slipped up" and conductor clearance to the ground was lost. However, if an extra tower has to be put in a 275/380 kV steel tower line it may cost £1,800 and, in addition, the expense of the delay in energizing the line is a serious matter.

Because of this increased risk, all surveys and profiles are more carefully checked. It is usual to start working from the level of the nearest Ordnance Survey bench mark and to check back to them at reasonable intervals, and on completion. This gives a check on levels, while distances and angles in the line can be checked on 6in or 25in to the mile maps. However, one or more of the surveyor's readings may be wrong. This risk may be eliminated by a second surveyor making a profile of the ground, and checking this against the original.

Aerial Survey

One development which should be mentioned is the use of aerial survey by which profiles are produced from stereoscopic photographs of a strip of land along the route. This is particularly useful for preliminary survey, and allows some movement of the line across the strip photographed. In cases where intensive development of an area is proposed, the whole of the ground may be photographed. The position of any line can then be shown on the photographs and sent back to the specialists who prepare profiles without further visits to the route, except to check that there have been no alterations, since being photographed, to either the ground (for ballast pits, etc.) or by new buildings. The firm who provide the photographs have a ground control who obtains ground levels through crops or woods, checks from bench marks and fixes angle pegs to suit the route profiled. The accuracy in this profile is guaranteed

Fig. 1.—Straight line 275 kV tower of the supergrid



* J. L. Eve Construction Co., Ltd.

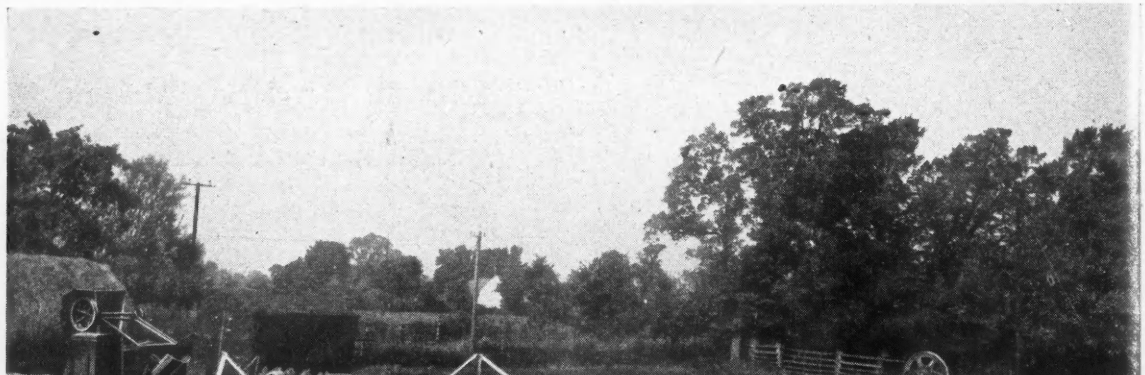
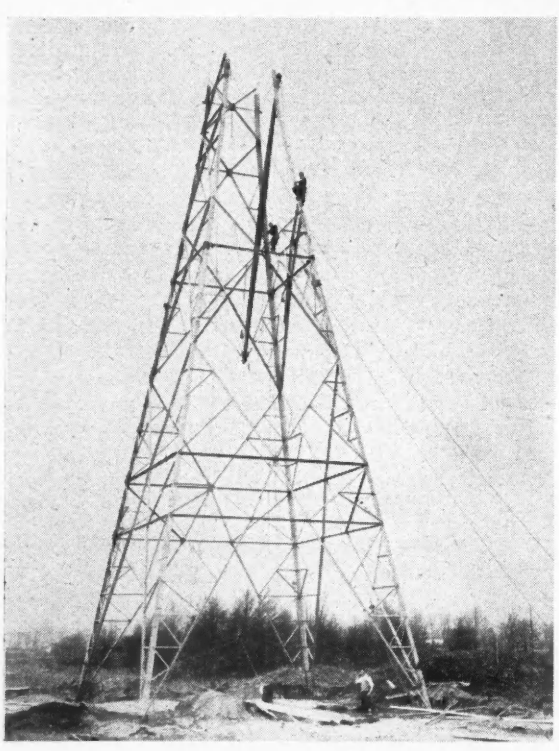
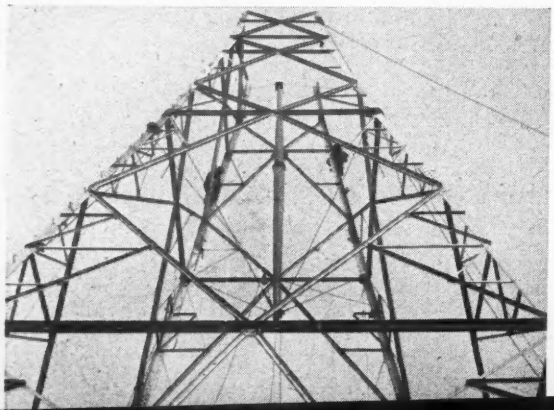


Fig. 2.—Aluminium stub-setting template in use



Figs. 3 and 4.—A floating derrick in use



to be within a foot, and the present cost is £6 9s per square mile photographed plus £15 per mile of profile provided.

As foundations get bigger it is worth while designing stub setting templates of aluminium instead of steel. Although the cost of a good design is more than that of steel, there is a big saving in handling the lighter aluminium. Another new point about this template is that the horizontal square frame members overlap in the middle of the sides. The old type template has these horizontal members projecting beyond each stub for all extensions below the maximum so that when a foundation is on a hillside special channels have to be dug to make room for the ends of these members.

The mixer hoppers have a division so that when one side is filled with sand and the other with 1½in stone the ratio is correct. There is no need to use separate gauge boxes, except for cement. The particular foundation shown in Fig. 2 was in poor ground, and twenty piles had been driven down 60ft through river mud to reach firm ground. The pile caps and the tie beams between these pile caps are being concreted with the stubs in place. There is over 80 cu yd of concrete in these pile caps. In this connection, it is interesting to mention the traffic which may pass into and out of one such angle tower site:—

	In	Out
Piling machine and gear	Approx. 80 tons	30 tons
Steel runners, etc., for timbering, template, concrete shuttering, etc.	10 tons	10 tons
Mixers, etc., and concrete materials	160 tons	—
Tower steel	24 tons	—
Conductors and insulators, etc.	70 tons	—
Surplus spoil to be removed	—	160 tons
	344 tons	200 tons

The traffic to and from such an angle tower site may be 544 tons; and this may have to be done when the ground is soft. It will be realized that there will be difficulties at times and special vehicles for working on soft ground are essential in winter.

Tower Erection

With the increasing height of towers it has become usual to use a power winch for lifting the sections of the tower after assembly on the ground. This reduces the drudgery

of erection, and reduces the number of men required. A power winch costing about £250 is available which has three speeds and reverse and is capable of lifting up to two tons.

A wood pole about 45ft long and about 8½in diameter at mid-point is erected vertically at one of the stubs, with a pulley block at the top for the lifting wire rope. The lifting rope and all gear should be strong enough to stall the winch rather than break if the load jams. A section of one of the legs nearly twice the lifting height of the derrick can then be lifted, complete with guys on the top, and bolted on to this stub. The derrick is skidded along the ground to the next leg until the bottom lengths of all four legs are erected.

The derrick is then raised up inside one of the legs of the towers by means of a hand winch. The top is controlled by guys and a short sling round both the derrick and the top of the leg already erected, while the winch lifting rope going through a pulley at the top of this leg is applied to the base of the derrick. The erection of the tower is continued from this position by inclining the top of the derrick to wherever it is required for lifting the next leg or set of bracings. The cross-arms are usually assembled in halves and lifted into position.

When a very tall tower is to be erected, or one on an isolated site where there is no room for guys, it is usual to use a floating derrick, as described by Eve and Brown.† One of these in use can be seen in Figs. 3 and 4. The derrick, which is 50ft long and weighs only 6 cwt, is made of 12 s.w.g. sheet steel with the winch lifting rope passing up through the centre. It has ball races at the ends to allow the top pulley to face in any direction required for lifting. Some points are worth noticing. The wire ropes supporting the base of the derrick have sacking under them to protect the galvanizing of the legs. The position of the top of the derrick is controlled in four directions by steel ropes going through shackles on each of the legs (Fig. 4).

These wire ropes are coupled to small sets of three and two blocks by means of Wallace toggles. If one set of blocks is slackened off and another set tightened, then the top of the derrick moves over. These Wallace toggles, named after the engineer of the J. L. Eve Construction Co., Ltd., who originated the idea, allow easy adjustment of the length of the wire rope without any sharp bends which are likely to damage it.

† "Erection of Tall Towers." J. L. Eve and R. C. Brown. I.C.E. Structural Paper, No. 11 (1945).

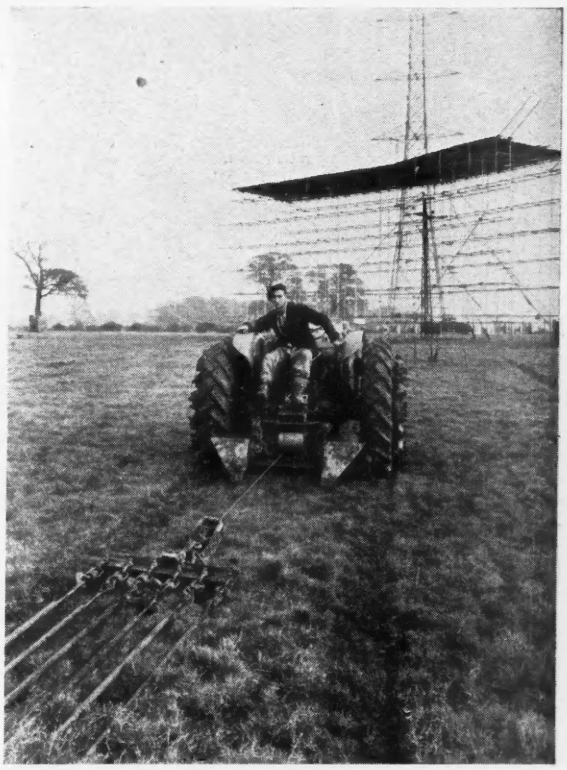


Fig. 7.—Six conductors being drawn out by a six-way bridle. In the background is a scaffolding over a live 33 kV line

Conductor, which is nearly always steel-cored aluminium and in lengths of about 4,700ft for 0·4 sq in copper equivalent, is usually delivered by low-loader vehicles from the works to the side of the nearest hard road. Fig. 5 shows how these drums, each of which weighs 2¾ tons, are reloaded on to a special ten-wheeled vehicle (all ten being driving wheels). These are the most generally suitable vehicles known for both field and road work and have a power winch (about 3 tons pull) just behind the front bumper. This can be used for either erection of towers, sagging conductors, or pulling itself or other vehicles out

Fig. 5.—A drum of conductor being hauled on to one of the special ten wheel vehicles used and (right) Fig. 6.—Swedish-designed self-braking drum stands

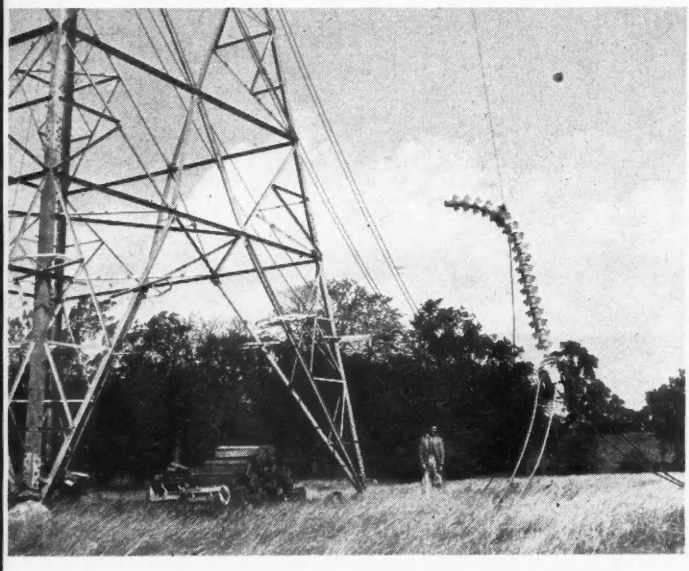


Fig. 8.—Lifting a suspension insulator set and twin conductors into position

of really soft ground, in addition to its use for raising drums of conductor on to the body of the vehicle. The winch rope is taken over the bonnet and the top of the driver's cab by two pulleys and coupled to a spindle through the drum to be raised. The skids shown are made of aluminium sections for lightness, and are hooked on to the rear bumpers which are an extension of the chassis on this vehicle.

When the drums of conductor have been taken to the point of the route where they are required, they are mounted on stands which allow the drums to revolve. The ends of the conductors are usually attached by cable stockings and through swivel hooks to a six-way bridle, and to a special 6-ton winch on the back of a "Fordson Major" diesel tractor. The bridle has skids fitted to ease its passage along rough ground, and also on gantries over roadways, etc. The tractor has an anchor which on being dropped buries itself as required by the load on the winch, the drum of which holds about 1,200ft of $\frac{5}{8}$in diameter steel rope. Damage to crops occasioned by taking the tractor over the field can be minimized by walking across with the end of the winch wire rope, and winching the conductors back to the tractor.

When the conductors have been pulled about 150ft beyond a tower, they are put through running-out blocks attached to the end of the suspension insulator set and lifted to the end of the cross-arms (Fig. 8). It will be seen that sacking is wrapped round the insulator set at the point where the steel lifting rope is attached. In addition to preventing damage to the galvanizing, this prevents undue bending at the lifting point. This bending can permanently damage the neck of the ball of the insulator unit where it fits into the cap of the next unit. So long as the bend between these two units is less than that between the next higher unit which is merely taking the weight of the top few units, then no damage is being done. The top few units are left free to facilitate coupling the suspension set to the cross-arm.

When the conductor is nearing its working tension none of the conductor weight is taken by the ground; the whole of it is taken by a very small arc on the running-out block. This weight may cause flattening of the aluminium strands outside the conductor and, in addition, nicking of the aluminium strands where they cross each other inside the conductor, particularly where the strands of the steel core bear on the aluminium.

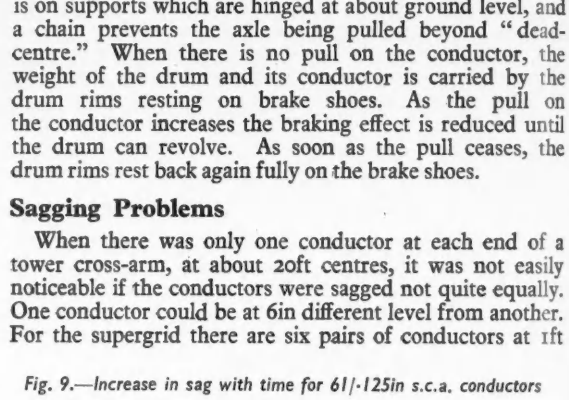
To reduce the intensity of this loading, in France and America a large pulley with a diameter about twenty-four times the conductor diameter is used in the running-out block. This makes the block very heavy to handle and expensive to buy. An alternative scheme is to use a much smaller grooved pulley with a rubber moulding bonded into the groove so that under the weight of the conductor the rubber is flattened and the load spread over a larger area so as to be much less intense. This is very much easier to handle and less expensive.

Special drum stands (Fig. 6) have been made in this country based on a Swedish design. The new drum stand is automatically self-braking, the braking effect can be varied to suit conditions, and the fuller the drum, the greater the braking effect. These very desirable features are obtainable very simply. The axle through the drum is on supports which are hinged at about ground level, and a chain prevents the axle being pulled beyond "dead-centre." When there is no pull on the conductor, the weight of the drum and its conductor is carried by the drum rims resting on brake shoes. As the pull on the conductor increases the braking effect is reduced until the drum can revolve. As soon as the pull ceases, the drum rims rest back again fully on the brake shoes.

Sagging Problems

When there was only one conductor at each end of a tower cross-arm, at about 20ft centres, it was not easily noticeable if the conductors were sagged not quite equally. One conductor could be at 6in different level from another. For the supergrid there are six pairs of conductors at 1ft

Fig. 9.—Increase in sag with time for 61/·125in s.c.a. conductors



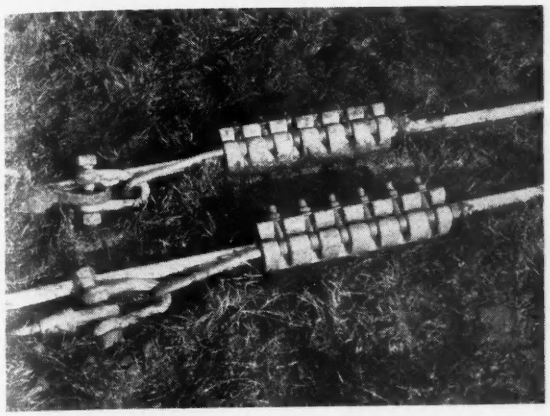


Fig. 10.—Two " come-along " clamps

centres. It is now apparent if each conductor of a pair is not within about 2in of the other. Thus greater accuracy of sagging is called for.

Another problem is the non-elastic stretch of the 0·4 sq in conductor which has only seven strands of steel to 54 strands of the same diameter of aluminium. The writer has measured this over a period of one year after erection, and the figures are now published for the first time. Fig. 9 shows this non-elastic stretch for an isolated short span of 712ft, and for a section with a ruling span of 1,177ft. It will be seen that both conductors stretched equally for about 36 days when the increase of sag was 11 per cent. After this the curves separated rapidly. For the more usual case of a long section the stretch slowed down until after twelve months it was about 15 per cent. In the other case of the isolated short span the stretch continued at a rapid rate and had reached 25 per cent after 280 days.

It is usual to allow for an increase in sag by erecting conductors with a tension 15 per cent in excess of the design value. In addition to this there is some adjustment obtainable by reducing the effective length of the links in the tension sets. However, it seems desirable to give extra ground clearance to these conductors.

This non-elastic stretch is at its greatest rate of increase immediately after sagging, and this makes it most desirable to sag simultaneously any two conductors forming a pair. Tower cross-arm movements during sagging (referred to later) make it doubly desirable. It is important that these conductors should have equal tensions applied during sagging, otherwise the one which has been subjected to the greater tension will have had more of the non-elastic stretch taken out of it and will stretch less after sagging and unequal sags will result.

In order to take out a little of the above stretch equally for a pair of conductors they can be tensioned to nearly 40 per cent over the design tension (but well below the maximum working load) and held for about twenty minutes. This is likely to exceed any subsequent tension applied during sagging; consequently no treatment it gets during sagging is likely to cause unequal non-elastic stretch afterwards.

In addition to all the above factors affecting the conductor sags, there are more complications due to the deflection of the ends of the tower cross-arms during sagging. Once a conductor has been marked for length, any subsequent movement of the arm from the position at marking, due to other conductors being sagged on the tower, will affect the sags of the marked conductor.

These tower deflections are appreciably greater than on 132 kV grid towers since the towers are taller and the longer cross-arms allow twisting deflections proportionally greater at the ends of the arms, and lastly, the high tensile steel mainly used for these towers allows a higher stress and therefore greater deflections.

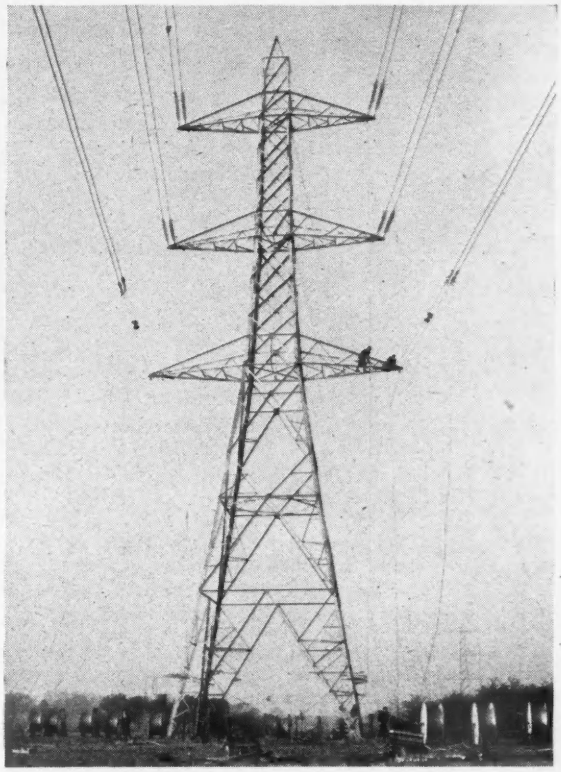


Fig. 11.—Sagging all four conductors on one level

The tension applied to each end of an angle tower cross-arm during sagging is about 6 tons, compared to about 30 cwt for the usual 132 kV lines, and if the same load is not applied simultaneously to the opposite end of the cross-arm, then considerable twisting of the cross-arms will occur. Theoretically, all these deflections might be considered to be reduced to zero by the time all the conductors were attached to the tower. Practically, this is very far from being correct, probably because of some slip between bolted surfaces at high initial loadings. The application of equal loads to the opposite faces of a tower certainly does not reduce the initial deflections to zero, and these must be taken into account when sagging. Since this cross-arm deflection after marking a conductor for length may easily be 4in, and the increase in sag for the deflection in a 1,000ft span is about 36in at 40 deg F the need for making allowance is obvious. These deflections for all types of angle tower and different conditions of sagging, can be determined by theodolites set up in line with the ends of the cross-arms about 200ft away from the centre point. Hundreds of measurements are necessary.

Sturton gives the results obtained on the Tilbury/Elstree line in his paper‡ and describes the allowances to be made in conductor lengths.

The sag measurements are now nearly always made by the aid of a telescope of some form (with a horizontal hair line) fixed at a measured distance down the tower leg to allow for the conductor sag at the ambient temperature

‡ " Sagging Twin ·4 C.E. S.C.A. Conductors." G. P. Sturton. *Proc. I.C.E.* Part III. August, 1955.

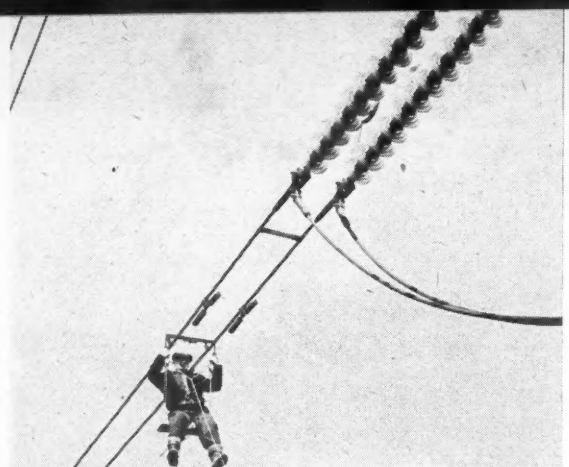


Fig. 12.—A linesman approaching the end of a tension set after inspecting spacers

and the length of the suspension set. This telescope sights on to a horizontal sag board similarly fixed to the adjacent tower. The bottom of the sag of the conductor should be on the hair line when sighting on to the top of the sag board.

Fig. 10 shows two six-bolt aluminium "come-along" clamps. The far side of the clamp is hinged, and the near side has hinged eye-bolts. The hairpin which forms the hinges is offset so that the shackle for the sagging winch rope is kept clear of and does not damage the aluminium strands of the conductor. Fig. 11 indicates how the conductors are brought up to sag all four conductors at each cross-arm level. It will be noted that these four conductors are sagged through pairs of equalizing blocks so that only two winches are needed to sag them. A ¼in diameter steel wire rope is taken from each "come-along" clamp to the end of the cross-arm and through blocks down to ground level so that force can be applied to neutralize any inequality of sag due to the friction of these equalizing blocks.

After marking the ¼in steel ropes with black tape to indicate the length required, the conductors are lowered to the ground, the s.c.a. conductors laid tight against the ¼in diameter steel ropes and the mark transferred, and the necessary adjustments made to allow for the length of the tension insulator set, and for the deflection of tower cross-arms during sagging, etc.

The title picture (page 1059) shows a pair of conductors going up to the cross-arm after being cut to length and attached to the insulator sets. It will be noted that because of limited space between the tension sets and the arm, a special single block is used. The pair of conductors, in the same section, on the opposite end of the cross-arm is brought up to tension and the load transferred to the cross-arm simultaneously. Failure to do this produces twisting of the towers which affects the sags. Two tractors with power winches are used for this sagging.

As soon after the conductors are sagged as is possible, spacers should be fitted to keep the pairs of conductors from clashing together in the wind. To do this, the position of the spacers is measured along the ground by equally dividing the span by the number of spacers to be fitted plus one. The maximum span to be fitted with two spacers per pair of wires is 650ft.

$$\text{Distance apart} = \frac{650}{2+1} = 217\text{ft}$$

Every 200ft increase of span requires an extra spacer.

The linesman gets on to a bosun's chair having two aluminium pulleys running along a pair of conductors. He is pulled along by means of a sash line by a man on the ground who also lines in the position of the spacers on the various pairs of conductors. In Fig. 12 he is seen approaching the end of a tension set after inspecting spacers already fitted.

A spacer at the end of the tension set keeps the conductors at 16in centres. This length of spacer is used only at the end of the tension sets. The tension insulator units are of 11in diameter and the standard 12in spacer is hardly long enough to avoid the risk of the discs coming into contact under some conditions. From the maintenance point of view, it might be preferable to make all such spacers 15in or 16in long.

The method usually employed on 132 kV lines to make jumpers at angle towers is to compress the jumper terminal on one end of a piece

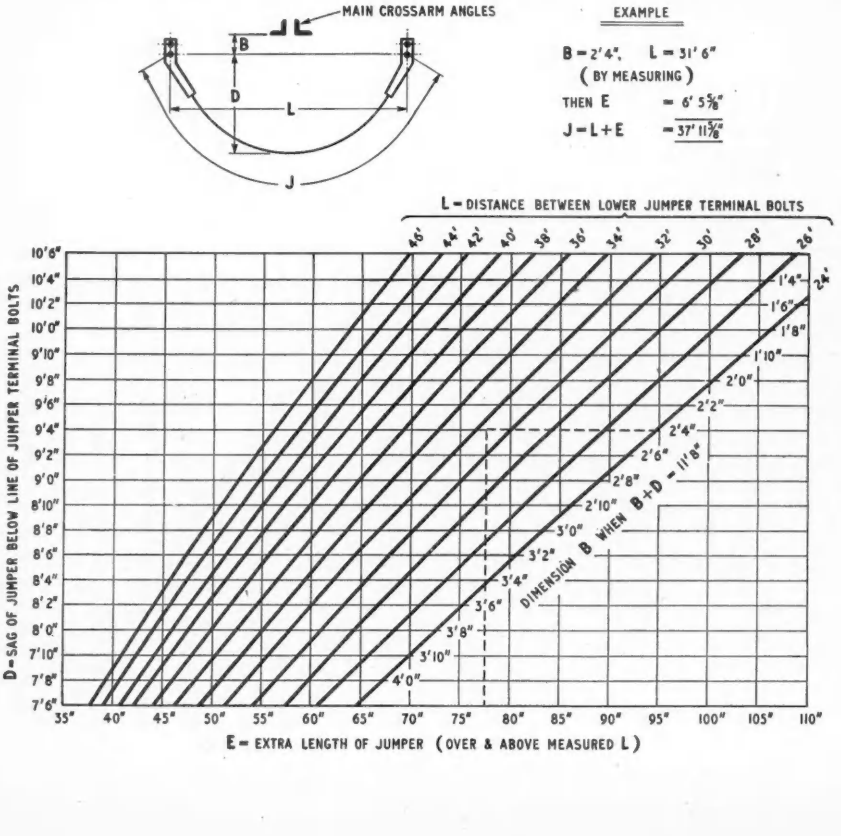

MAIN CROSSARM ANGLES
B
D
L
J
EXAMPLE
B = 2'4", L = 31' 6"
(BY MEASURING)
THEN E = 6' 5⅝"
J = L + E = 37' 11⅝"
L = DISTANCE BETWEEN LOWER JUMPER TERMINAL BOLTS
D = SAG OF JUMPER BELOW LINE OF JUMPER TERMINAL BOLTS
E = EXTRA LENGTH OF JUMPER (OVER & ABOVE MEASURED L)
DIMENSION B WHEN B+D = 11'8"

Fig. 13.—Chart for determining the length of jumpers

of conductor. This is taken up the tower, fixed to the tension set on one side of the cross-arm, and the other end of the conductor is held against the other tension set and marked for cutting to length, when the clearances to the cross-arms above and/or below, and to the tower are correct.

The jumper is then lowered to the ground (the compressor is normally too heavy and awkward for taking up and operating up the tower), the conductor is cut to length and the other jumper terminal is compressed on to it. The jumper then goes for a second journey up the tower to be bolted on to the tension sets.

Tension insulator sets for 275/380 kV measure 15ft from the cross-arm to the jumper terminal (compared with about 7ft for 132 kV) so that the actual jumper connection may be up to 50ft long. The conductor is twice the weight per foot run and the required clearance 11ft 6in from live metal to earthed metal compared with 4ft 2in for 132 kV.

These increases in dimensions make it much more difficult and time wasting to fit jumpers in the old way, and the writer made a chart (Fig. 13) so that by measuring two dimensions "B" and "L" sufficient information was given to make the jumper. An example is given to show how the chart is used.

By this means, and having measured for the jumpers on two or more angle towers, then all of them can be made up under shelter in the stores, and taken out and bolted in place when required. In Fig. 14 two linesmen are seen fitting 8in spacers to these jumpers.

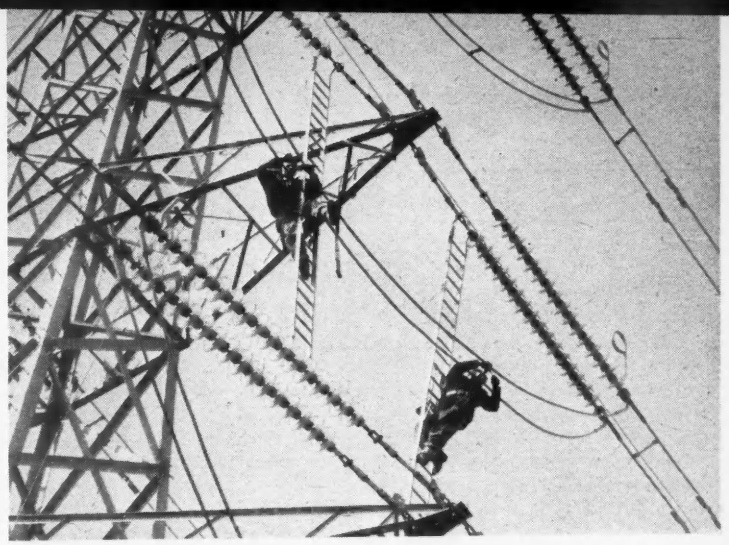


Fig. 14.—Fitting 8in spacers to jumpers

Large Orders for Diesel Locomotives

Electrical Manufacturers' Share

LAST week the British Transport Commission announced the placing of contracts of a total value of nearly £10 million with British manufacturers for 141 main line diesel locomotives (130 diesel-electric, 11 diesel-hydraulic) and 30 power units required as part of the £1,200 million plan now in progress for the modernization and re-equipment of British Railways. The power units will be used for locomotives to be built in British Railways workshops.

Over the whole period of the modernization plan it is proposed to build some 2,500 main line diesel locomotives, but this number is subject to variation as the plan develops. The contracts now placed are for the 171 locomotives forming the pilot scheme under which trials will be made before placing any further orders. These contracts comprise three main designs: Type A (800-1,000 h.p., for freight); Type B (1,000-1,250 h.p., for mixed traffic); and Type C (2,000 h.p. or over, for heavy duties).

The main contracts for complete locomotives have been placed as follows:—Birmingham Railway Carriage & Wagon Co., Ltd., 20 locomotives of Type B (1,160 h.p.); British Thomson-Houston Co., Ltd., ten of Type A (800 h.p.); Brush Bagnall Traction, Ltd., 20 of Type B (1,250 h.p.); English Electric Co., Ltd., ten of Type C (2,000 h.p.), ten of Type B (1,100 h.p.) and 20 of Type A (1,000 h.p.); Metropolitan-Vickers Electrical Co., Ltd., 20 of Type B (1,200 h.p.); North British Locomotive Co., Ltd., ten of Type B (1,000 h.p.), ten of Type A (800 h.p.) and 11 diesel-hydraulic locomotives, six of Type B and five of Type C.

Contracts for power equipment sets for locomotives to be built in B.R. workshops have been placed with Sulzer Bros. (London), Ltd., ten for locomotives of Type C (2,300 h.p.); and the B.T.H. Co. 20 for locomotives of Type B (1,160 h.p.). These main contracts will also involve substantial orders for engines, electrical equipment, and mechanical parts. Details of this further allocation are given in the accompanying table. Delivery time of the first locomotives under the main contracts will vary from eighteen months to two years.

In announcing the contracts the British Transport Commission states that over 200 tenders or variations of tenders were received from manufacturers following the issue of the specification and invitations to tender. The contracts spread the work as widely as practicable over the locomotive manufacturing and associated industries and, subject to the general limits of the Commission's specification, will enable manufacturers to introduce their own ideas and special features in a manner which should prove beneficial, from the standpoint of long-range testing, to both British Railways and to the manufacturers. The latter will also be helped to a considerable extent indirectly in their efforts in the export field.

The types of diesel engines to be used in the locomotives include products of British manufacturers with actual experience in this country or in the overseas market. In addition, the Commission is to carry out extensive trials of the Sulzer (Swiss) and M.A.N. (German) engines, both of which are now made in this country under licence. The eleven locomotives to be built by the North British Locomotive Co. will embody Voith (German) hydraulic transmissions, which are now manufactured in this country under licence.

The Commission says that it has actively under review its future policy for the manufacture and repair of diesel and electric locomotives. The present orders, being "pilot" models for trial purposes, should not be taken

SUMMARY OF EQUIPMENT

Type	No.	Main Contractor	Engine	Transmsn. Equipment	Mech. Parts
C.					
	Power Equipments				
	10	Sulzer	Sulzer	Crompton-Parkinson	British Railways
	Complete Locos.				
	10	English Elec.	English Elec.	EnglishElec.	English Elec.
	5	North British	M.A.N.	Voith	North British
B.					
	Power Equipments				
	20	B.T.H.	Sulzer	B.T.H.	British Railways
	Complete Locos.				
	10	English Electric	English Elec. Deltic	English Elec.	English Elec.
	20	Birmingham Carriage	Sulzer	Crompton-Parkinson	Birmingham Carriage
	20	Brush Bagnall	Mirrlees	Brush	Bagnall
	20	Metro-Vick.	Crossley	Metro-Vick.	Metro-Vick.
	10	North British	M.A.N.	G.E.C.	North British
	6	North British	M.A.N.	Voith	North British
A.					
	Complete Locos.				
	20	English Electric	English Elec.	English Elec.	English Elec.
	10	B.T.H.	Davey Paxman	B.T.H.	Clayton
	10	North British	Davey Paxman	G.E.C.	North British

as an indication of permanent policy. Although detailed specifications of all the new diesel locomotives under the pilot scheme have been prepared, their external form and liveries have yet to be settled. The Commission, in conjunction with the manufacturers, is paying special attention to æsthetic external design, on which it is obtaining expert advice, and pending decisions on this aspect—which will not delay construction—outline drawings of the new designs are not yet available.

Supplementing the official announcement by the British Transport Commission, the Metropolitan-Vickers Electrical Co., Ltd., say that the twenty diesel-electric locomotives which they are supplying will be suitable for hauling both passenger and goods trains. The locomotives will have 1,200 h.p. engines, giving a maximum speed of 75 m.p.h. and a maximum tractive effort of 50,000 lb. The weight of each locomotive, including 470 gal of fuel and 600 gal of train heating water, will be 91 tons.

The body of the locomotive will contain the engine, generator and auxiliary electrical machines and train heating boiler, with a driving cab at each end; it is carried on two bogies, one with two axles and the other with three axles, each axle being driven by its own motor. The two-stroke-cycle type engines will be made by Crossley Bros.

The 20 locomotives ordered from Brush Bagnall Traction, Ltd., are of the AIA-AIA type, which means that the superstructure is mounted on two bogies, each bogie having three axles of which the two outer axles are motored, the centre axle being used for carrying purposes only. The locomotives have a driving cab at each end with provision for connecting gangways which will be used when the locomotives are coupled together for multiple working.

Each of the two bogies has six wheels with a wheelbase of 14ft. The overall length of each locomotive is 57ft and in working order it weighs 104 tons. The power unit is a Mirrlees V-form 12-cylinder turbo-charged, four-stroke oil engine developing 1,250 h.p. at 850 r.p.m., coupled to a Brush generator with a continuous output of 828 kW. An auxiliary generator is flange-mounted on the main generator to provide power for the air brake compressor and the vacuum compressors.

The traction motors, control gear, main generators and superstructure will be manufactured by the Brush Electrical Engineering Co., Ltd., and the diesel engines by Mirrlees, Bickerton & Day, Ltd. The locomotives will be assembled in the Brush Bagnall erecting shop at Loughborough.

Twenty of the locomotives ordered from the English Electric Co., Ltd. (Type A) will be of the 1,000 h.p. double bogie (Bo-Bo) type with English Electric 8 SVT diesel engines. Generally similar locomotives are in service on the Nordeste Railway of Brazil.

Another ten of the locomotives ordered (Type B) will be of the 1,100 h.p. double bogie (Bo-Bo) type with nine-cylinder super-charged Napier Deltic engines. It may be noted that the 3,300 h.p. Deltic locomotive which has been undergoing preliminary trials on British Railways for the past month, employs two 18-cylinder Napier Deltic engines.

The remaining ten locomotives (Type C) will be of the 2,000 h.p. double bogie type and will incorporate the 16 SVT English Electric diesel engine. They will follow closely English Electric equipment already in service for some years in the London Midland and Southern Regions for express services.

The ten locomotives which the British Thomson-Houston Co. is supplying are 800 h.p., Bo-Bo locomotives with Paxman 16YHXL engines running at 1,250 r.p.m. They will be single-cab locomotives of the same general design as B.R. No. 10800 which was equipped by B.T.H. in 1949. The starting tractive effort is 38,000 lb and the maximum speed 60 m.p.h. The twenty B.T.H. 1,160 h.p. power equipments for Sulzer type 6LDA28 engines running at 750 r.p.m. will give a starting tractive effort of about 40,000 lb. The locomotives will be suitable for a maximum speed of 75 m.p.h. All the locomotives will be equipped with B.T.H. main generators, traction motors, auxiliary machines and controls.

Referring to its share in these contracts, the General Electric Co., Ltd., says that in the ten main line North British locomotives the power equipment will comprise a pressure charged 12-cylinder N.B.L./M.A.N. 1,000 h.p. 1,500 r.p.m. engine direct coupled to a G.E.C. main generator with overhung auxiliary generator. Each axle will be driven through Wiseman resilient gears by a nose-suspended forced-ventilated traction motor. Control will be by a combination of generator field control and variation of engine speed, providing eight engine speed steps. Automatic torque control through an oil servo regulator will be available on all controller notches. These locomotives are designed for a maximum axle loading of 18 tons and a top speed of 75 m.p.h. There will be a driving cable at each end.

The ten North British branch line locomotives will be of similar wheel arrangement but will have a driving cab at one end only, with duplicated controls for driving from either side. The 16-cylinder Paxman YHXL 800 h.p. 1,250 r.p.m. engine will be direct coupled to a flange-mounted G.E.C. main generator with overhung auxiliary generator. Forced-ventilated, nose-suspended traction motors will drive the axles through Wiseman resilient gears. The control system will be generally similar to that of the main line locomotives. The axle load will be 17 tons and the maximum speed 60 m.p.h. Most types will be arranged for multiple unit working.

Crompton Parkinson, Ltd., who are to supply electrical equipments for thirty main line locomotives, say that each equipment includes a main and auxiliary generators; four or six traction motors for mixed traffic and heavy duty locomotives, respectively; four or five auxiliary machines for driving compressors, exhausters, fans, pumps, etc.; and control equipment. All the generators and motors will be made in Crompton Parkinson's Chelmsford works and the control gear will be built to the company's requirements by Allen West & Co., Ltd. The value of the order is about £750,000.

Flat Pressure Cable

Its Use in Submarine and Land Installations Discussed

THE discussion on the flat pressure cable, the subject of a paper presented before the Supply Section of the Institution of Electrical Engineers which was reported in our last issue, was opened by Mr. F. J. Lane (C.E.A.), who expressed the view that the cable had many important advantages for short installations but would entail serious difficulties for a major installation. The drum method of laying sea cable did not involve the twisting and untwisting associated with feeding the cable into and out of the hull of a ship, but the drum required for crossing the Channel would cost £50,000 to £60,000.

Mr. R. Tellier (Electricité de France) referred to experimental work at the Fontenay Research Centre, where the cable had withstood 1,115 heating cycles so far carrying about 275 A. During summer conditions some oil had to be removed from the cable to prevent the pressure getting too high. Consequently in winter conditions the minimum pressure was below the limit given by the manufacturer. The floating drum method for laying the cable had proved satisfactory during the sea trials for the cross-Channel project, once the brake had been provided with a pneumatic control.

Dr. A. N. Arman (Pirelli-General) said that on level routes or for submarine use the cable was entirely satisfactory, but not all routes were level. The static head involved would appear to influence its load-carrying capacity considerably. The length which could be dealt with in the final drawing operation within the sheath was almost as much of a limitation as the laying-up machine. He was surprised to see the long lengths of cable that had been made.

Mr. D. B. Irving (L.E.B.) regarded the cable as a notable development. Two advantages were claimed—the longer manufacturing lengths and the absence of external accessories. A prospective user confronted with a new type of cable asked, first, whether it was as reliable as other contemporary types and, secondly, whether it would cost less to make and install. The paper gave no answer to the second question. He expressed disappointment that research similar to that undertaken by Electricité de France had not been carried out in this country.

Mr. C. C. Barnes (C.E.A.) pointed out that there were five proved systems of super-voltage cables in this country against which the case for flat pressure cable had to be considered. The two criteria were whether it had a technical advantage over other systems and whether it was more economic. In answer to the first question the authors provided only broad general comparisons, and economic comparisons appeared to have been deliberately excluded. He asked whether the floating drum was to be recommended where tidal conditions were difficult, particularly as it involved slow laying and great care in manœuvring.

Mr. J. Banks (B.I.C.C.) observed that while the self-contained cable seemed an attractive proposition, it would be judged by its economics. The copper would have to be used to roughly the same extent as in standard cable.

Mr. C. H. Gosling (C.E.A., London Division) said that the recent installation of 500 to 600 yd of cable had been facilitated by laying ducts across main roads prior to pulling, and enquired whether this cable could be pulled through ducts and what rating could be expected. Bends in duct crossings might cause difficulties.

Mr. E. E. Hutchings (E.R.A.) said the determination of internal thermal resistance was simpler with conventional designs than with flat cable. Were complete models used, he asked, and did any difference have to be made in the potential applied to the three electrodes representing the conductors? In commenting on the reduction of current rating of 2·3:1 between flat and triangular cable, Mr. Hutchings asked whether the temperature rise was the same in both cases.

Mr. D. T. Hollingsworth (B.I.C.C.) pointed out that the raw material in the selling price was 70 per cent. He calculated that the material content for MVA transmitted with this type of cable would go up by 3 to 4 per cent, which very largely represented the cablemakers' profit margin, so the cable would seem to be hardly competitive for land use.

Mr. G. S. Buckingham (Midlands Electricity Board) commented that no cablemaker made profit on cable, but in view of the astronomical charges for joints he hoped that the long lengths possible with flat pressure cable would encourage its use for land cables.

Mr. F. S. Edwards (Metropolitan-Vickers) wished for more information about impulse tests. These cables were very long and had a large capacitance; both characteristics introduced serious difficulties in impulse testing.

Thomas Hawksley Lecture

THE forty-second Thomas Hawksley Lecture was delivered before the Institution of Mechanical Engineers by Dr. D. M. Newitt (Imperial College of Science and Technology), who gave an account of recent researches into the properties of matter at high pressures. In some instances, as in steam raising, stepwise increases in temperatures and pressures were leading to predictable improvements in cycle efficiencies. In others, as in exploring the structure of matter, the immediate object was the attainment of temperatures and pressures likely to bring about an overlapping of the electron phase spaces. For this purpose, pressures far in excess of any yet realizable in the laboratory were required.

At the lower end of the scale was a pressure domain in which the behaviour of a fluid was determined largely by a balance between short-range repulsion forces and long-range attractive forces of its atoms or molecules. At temperatures not far removed from room temperatures, this domain might extend up to 50,000 bars (1 bar=14·5 lb/sq in), after which the liquid state would probably cease to exist. In the second domain, which overlapped and extended to 10^6 bars, solids in general underwent polymorphic transitions, giving rise to stable phases of progressively increasing density; thus, over a range of 20,000 bars, ice existed in seven different forms.

In the third domain, upwards of 10^6 bars, as postulated at the centre of the earth and in many stars, a breakdown in the structure of matter was expected. At present industrial plant could be operated at 3,000 bars. In the laboratory experiments at 15,000 bars could be carried out over a temperature range of several hundreds of degrees, while a limited amount of work had been done up to 100,000 bars —probably the extreme limit obtainable with existing materials and methods of plant construction.

PARLIAMENTARY REPORT

Choosing Between Gas and Electricity

Mr. Sorensen asked the Minister of Fuel and Power to what extent his department made tests to determine the respective advantages of electricity and gas for domestic and other purposes in order to offer objective guidance to the public in their choice of alternatives apart from the sectional advocacy of the separate gas and electricity undertakings.

Mr. Joynson-Hicks, Parliamentary Secretary, Ministry of Fuel and Power, replied: "None; but the National Industrial Fuel Efficiency Service provides large-scale users with a comprehensive advisory service."

Gold Coast Project

Mr. Lennox-Boyd, the Colonial Secretary, in reply to Mr. James Johnson, said it was hoped that the report of the Volta River Preparatory Commission containing revised estimates of the cost of the project and of the time of construction before power would become available, would be published about the middle of next year. He could not anticipate its contents or the decision of the parties concerned whether to proceed with the project. The Preparatory Commission had spent £530,000 up to 30th September last, one-half of which would be met by H.M. Government. Of the total, £430,000 was the cost of engineering investigations and designs. The rest was the cost of investigations and surveys carried out by the Preparatory Commission. In addition, other expenditure had been incurred by the aluminium companies and the Gold Coast Government.

Nuclear Power

Replying to Mr. Warbey, the Minister of Works (Mr. Birch) said the capacity of the six additional atomic reactors to be erected by the Atomic Energy Authority would be about 200 MW. It was too soon yet to say exactly when they would come into operation, but it was likely to be in 1959 or 1960.

Mr. Birch informed Mr. Mason that considerable publicity for Britain's atomic energy achievements was being given in all parts of the world by C.O.I. and U.K.A.E.A. publications, by exhibitions and in other ways. A number of formal and informal collaboration agreements had been made with Commonwealth and other countries, and the United Kingdom was one of the sponsors of the proposed international Atomic Energy Agency. No country had yet made specific offers of fuel for power stations. The United Kingdom had offered a limited amount of fuel for projects to be sponsored by the proposed international agency, and arrangements for the supply of fuel for research reactors were included in a number of agreements which the United Kingdom had concluded with other countries.

Mr. Palmer asked the Prime Minister if he would now make a statement on the purpose and results of the private conference on atomic energy attended by official representatives of the United States, France, the U.S.S.R., Canada, Czechoslovakia and the United Kingdom at Geneva in August, following the United Nations conference on the same subject.

Sir Anthony Eden said that the discussions referred to were concerned with certain technical aspects of the problem of safeguarding fissile material against diversion from peaceful uses. A useful exchange of technical ideas took place and the problems would be further studied by the Governments represented at the conference.

United States Contract Conditions

Mr. Bottomley asked the President of the Board of Trade if he would make a statement about the awarding of the United States contract for the Minidoka Reclamation Scheme in Idaho to a United Kingdom undertaking and if he would make a statement concerning the new rules adopted by the United States Department of the Interior in awarding contracts to foreign competitors as it affected British interests. Mr. Grimond asked what representations had been made to the United States Government on the alterations of the rules governing their acceptance of foreign tenders.

Mr. Low, Minister of State, Board of Trade, said the new rules announced by the Department of the Interior provided that when the lowest United States bidder offered equipment which would be manufactured largely in an area of substantial unemployment, the addition to the lowest foreign bid for the purpose of appraising the bids should be 12 per cent, as compared with 6 per cent in other cases. It was on the basis of these rules that the contract for the Minidoka scheme had been awarded to an English firm. This decision helped to clarify the conditions under which these contracts might be awarded in future and there was certainly no question of making representations to the United States Government in regard to it.

Coal Imports

In answer to Mr. Peyton, the Minister of Fuel and Power (Mr. Geoffrey Lloyd) submitted a table showing that imports of coal into the United Kingdom this year were estimated to amount to 12 million tons. From January to October the total was 9·5 million tons the average c.i.f. value of which per ton was £6·34. Of this amount 4·1 million tons (average c.i.f. value £6·85) came from the United States, 2·6 million tons (£5·65) from France, 1·3 million tons (£5·48) from Belgium and 1·1 million tons (£6·9) from Poland.

Exports to the U.S.S.R.

Mr. Ian Mikardo asked the President of the Board of Trade what was the maximum capacity of turbo-generators the export of which to the U.S.S.R. and Eastern Europe was now permitted.

Mr. Low said that the embargo operated at 60,000 kW. Turbo-generators of a rating between 5,000 kW and 60,000 kW might be exported within quantitative limits. Turbo-generators of a rating of less than 5,000 kW could be exported freely.

Asked to place before the House details of certain categories of Britain's exports to the U.S.S.R., the President of the Board of Trade gave tabulated information which included the following particulars of electrical exports to Russia:—

Class of Equipment	Jan.-Oct., 1953 £000	Jan.-Oct., 1954 £000	Jan.-Oct., 1955 £000
Generating sets, generators and parts ...	71	1,442	827
Electric cables, wires, strips and strands, insulated ...	87	146	905
Scientific electrical instruments (excluding telegraphic and telephonic) ...	100	215	272
Other electric machinery, apparatus and appliances	78	97	672
Total of electric machinery, apparatus and appliances ...	336	1,900	2,676

Cable Company's Factory

The President of the Board of Trade was asked, in view of the decision of the Craigpark Cable Co., Flemington Street, Glasgow, to close down its factory this month, with the consequent paying off of 350 employees, what steps he proposed to take to introduce a new industry in the factory. He replied that his officers brought that factory to the attention of industrialists who were seeking new quarters. He understood that only three men and six women of the 281 workers so far declared redundant remained on the register of unemployed.

Rental Agreements

Mr. Derek Walker-Smith, Parliamentary Secretary, Board of Trade, told Mr. Hynd that investigations were being made into ostensible rental agreements which might be in breach of the Hire-Purchase and Credit Sale Agreements (Control) Order, 1955, and

the Board of Trade intended to prosecute whenever there was evidence to warrant it.

Recruitment of Science Teachers

Mr. Stan Awbery asked the Minister of Education what steps he was taking to recruit more science teachers.

Mr. Vosper said he hoped some improvement would result from the increased salary allowances now available for teachers of advanced work, from the decision announced last July to allow the deferment from National Service of certain graduates in science and mathematics who took up teaching, and from the growing recognition of the importance of this work. But the only long-term remedy lay in a large increase in the output of scientists generally, and it was the policy of the Government to secure such an increase from schools, technical colleges and the universities.

Blyth Power Station

The Blyth Generating Station (Ancillary Powers) Bill, which was passed through the House of Lords, was considered by a Private Bill Committee of the House of Commons last week. The committee consisted of Wing-Comdr. Grant-Ferris (chairman), Mr. C. Armstrong, Mr. David Griffiths and Mr. Bernard Taylor. The objectors to the Bill are the Northumberland County Council, the Whitley Bay, Tynemouth, South Shields and Sunderland Corporations, the Northumberland Fisheries Committee, and the Northumberland and Tyneside River Board.

Purchase Tax Amendments Rejected

When the Budget proposals were further considered in committee by the House of Commons on Monday, Mrs. Eirene White moved an amendment to delete the proposed 60 per cent tax on space and water heaters which did not use mains supplies of electricity or gas. She said that these articles had been exempt from tax and the high rate now to be charged would be hard on people in rural areas where mains supplies were not available.

Replying for the Government, Mr. Henry Brooke, Financial Secretary, Treasury, said that the reference to electricity and gas mains in the Bill was not a deliberate attempt to hit at people living in remote rural areas. It arose from the phraseology used in the Finance Act, 1947. He had no information of any electrical appliance for which this exemption could be claimed; the issue really was confined to heaters worked by bottled gas. When electricity supplies were taken to a village it was possible for people to make a choice, and it was then seen that the gas-operated heaters had an artificial tax advantage.

The amendment was negatived by 241 votes to 199.

Mr. Coldrick moved an amendment to exempt from the new purchase tax provisions cooking utensils incorporating heating elements, irons, interval timers, kitchen scales, and weighing machines, wringers and mangles. He said that the price of a £5 electric kettle would, as the result of the additional tax, be increased to £6 5s. Was the Chancellor suggesting that women who went out to work should be driven to lighting a fire and boiling a kettle in the old fashioned way? The extra use of coal would be far more detrimental to the national economy than if electric kettles were used.

Mr. Donald Chapman said that a recent *Bulletin for Industry* issued by the Treasury indicated that exports of electric toasters in the first nine months of this year had gone up by 75 per cent, while home consumption increased by less than 10 per cent; the exports of electric irons had gone up by about 20 per cent, while home consumption had increased by only about 2 or 3 per cent; there had been no increase in the exports of electric kettles in the same period, yet there was an increase of 30 to 35 per cent in home consumption. If this list of articles to be taxed was drawn up in relation to the export trade, why should the Government penalize those firms which had been doing a very good job?

Sir Edward Boyle, Economic Secretary to the Treasury, replying to the debate, joined with Mr. Chapman in paying a tribute to the exporting achievements of firms engaged in making irons, toasters and percolators. In order to keep our economy on an even keel there must be some general curtailment of consumer demand and it would be illogical to grant special exemptions for these articles since they used metal and competed for the same resources that were used in producing goods in important export industries.

The amendment was negatived by 244 votes to 207.

Resale of Electricity

Mr. Storey asked the Minister of Fuel and Power if he would introduce legislation to amend the Electricity Act, 1947, so as to enable area electricity boards to fix maximum prices for the resale of metered electricity.

Mr. Joynson-Hicks, Parliamentary Secretary, Ministry of Fuel and Power, said the Minister would certainly consider including this matter in future amending legislation.

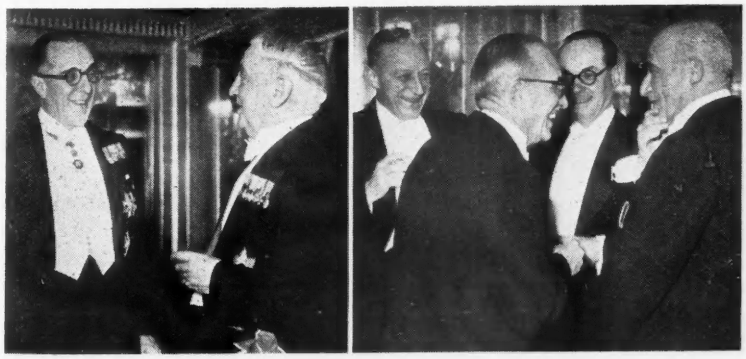
R.I.C. Annual Dinner

About 600 members and guests attended the annual dinner of the Radio Industry Council at the Dorchester, London, W.1, on 23rd November. Sir Edward Appleton, G.B.E., K.C.B., F.R.S. (president of the Council), was in the chair and the principal guest was Sir Walter Monckton, K.C.M.G., K.C.V.O., M.C., Q.C., Minister of Labour and National Service.

In proposing the toast "The Radio Industry" Sir Walter Monckton said that the present manpower shortage would be relieved by automation which had gained great impetus from the achievements of the electronics industry. Automation called for flexibility on the part of management and a readiness by the workers to accept change, which was a subject for joint consultation. Automation would increase the need for skilled labour and for scientists and technologists and thus provide great opportunities for young people leaving school. The radio industry should attract and train a supply of young men and women of the kind that would be needed in the future. He congratulated the Council on its apprenticeship scheme, under which large numbers of apprentices had been registered.

Mr. G. Darnley-Smith, C.B.E., chairman of the Radio Industry Council, responded to the toast. The health of the guests was proposed by Sir Vincent de Ferranti, M.C., and a reply was made by Dr. C. Hill, the Postmaster-General.

Left: Sir Walter Monckton with Sir Edward Appleton. Right: Mr. E. E. Rosen, Sir Vincent de Ferranti, Mr. E. K. Cole and Sir Harry Railing



PERSONAL AND SOCIAL

News of Men and Women of the Industry

Mr. G. A. Cheetham, A.M.C.T., M.I.E.E., managing director of Ferguson Pailin, Ltd., retired at the end of November. He was appointed managing director in 1942, up to which time he was manager and chief engineer of the Instrument and Meter Department of the Metropolitan-Vickers Electrical Co., Ltd. Before joining Metropolitan-Vickers in 1913 he had spent some years with Ferranti, Ltd., in the Switchgear, Meter and Instrument Departments. In 1935 Mr. Cheetham was chairman of the North Western Centre of the Institution of Electrical Engineers and he is a past-president of the Manchester and District Engineering Employers' Association. On behalf of the staff and works personnel Mr. J. R. Wilkinson presented Mr. Cheetham with a television set at a recent gathering.

Mr. Cheetham is succeeded as managing director by **Mr. J. R. Wilkinson,** B.Sc.Tech., M.I.E.E., F.Amer.I.E.E., who has been sales director since 1942 and was previously London manager.

The following further changes at Ferguson Pailin, Ltd., are announced: **Mr. G. Pailin,** one of the founder directors, who has been in indifferent health for some time, has resigned. **Messrs. E. M. Dakin,** A.M.C.T., **H. M. Hawkswood, R. A. Rowbottom,** A.M.C.T., and **L. F. Ryland,** B.Sc., M.I.E.E., have been appointed to the board.

Mr. Dakin has been with the company since 1917 and for many years has been manager of the Designs Department. He is on the B.S.I. Committee for electric switch and control gear and is a member of the Committee on Switchgear Standardization set up jointly by the electricity supply and electrical manufacturing industries. He has made a number of visits overseas in connection with engineering and design matters.

Mr. Hawkswood, besides retaining control of the London office, will also be responsible for export. He served in the Life Guards and Royal Engineers in the 1914-18 war and after five years with Whipp & Bourne, Ltd., and later Veritys, Ltd., he joined Ferguson, Pailin in 1924 as a sales engineer, subsequently becoming assistant manager and then, in 1942, manager, of the London office.

Mr. Rowbottom spent his early years with Electromotors, Ltd., and then as an apprentice with Ferguson, Pailin. After a few years as electrical engineer of a paper mill he returned to Ferguson, Pailin and later became manager of the Outside Erection Department. In 1949 he was appointed works manager, which position he will retain.

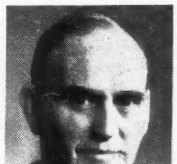
Mr. Ryland, who becomes home sales manager, commenced with the company in 1925 as a college apprentice. Subsequently he became a sales engineer and then principal assistant to the sales manager. In 1942 he was appointed manager of the Sales Engineering Department and in this capacity has made a number of visits overseas. He retains control of the Sales Engineering Department.

In our last issue we recorded the election of **Mr. R. G. Brandon** as president of the Electrical Trades' Commercial Travellers' Association. At the recent annual meeting of the Association **Mr. W. Candelatt** (Hotpoint Electric Appliance Co.) was elected chairman for 1955-56 and among other officers elected were **Mr. P. E. Pike,** hon. general secretary, and **Mr. A. Watson,** hon. treasurer.

At this meeting allocation of monies were made as follows, including donations from the Midlands and North Western Branches, and also one of £75 from Mr. D. C. E. Barrie:—£350 to the Electrical Industries Benevolent Association, and £153 to the Commercial Travellers' Schools. A vote of thanks was proposed by Mr. S. W. Graefe to Mr. A. Haywood, the retiring president, and by Mr. Shuter to Mr. H. Bowen, the retiring chairman. A dinner-smoker will be held on 9th December at the Windsor Castle Hotel, Victoria, S.W.1 (6.30 for 7 p.m.). Tickets (16s 6d each) can be obtained from Mr. A. J. Murray, the entertainments secretary, c/o British Electric Lamps, Ltd., 228, Westminster Bridge Road, London, S.E.1.

Mr. Harold Attwooll has resigned from Wall & Attwooll, Ltd., and has been appointed Portsmouth area manager with the St. Helens Cable & Rubber Co., Ltd., operating from its branch at 76, Marmion Road, Portsmouth, as from 1st December. His private address is 56, Carmarthen Avenue, Cosham, Portsmouth.

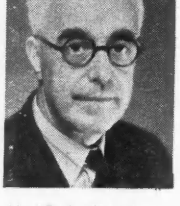
Sir Godfrey Ince, Permanent Secretary of the Ministry of Labour and National Service, who is to retire from the Civil Service next January, has been appointed chairman of Cable & Wireless, Ltd., and its associated companies in succession to **Major-General Sir Leslie Nicholls.** He will take up his new post on 1st February. Sir Leslie Nicholls announced in July that he wished to relinquish office on 31st January. The management of Cable & Wireless, Ltd., was strengthened in March, 1954, by the appointment of Mr. H. H. Eggers to be an additional managing director, working jointly with Mr. N. C. Chapling. Sir Godfrey Ince will not, therefore, be called upon to devote his whole time to the chairmanship.



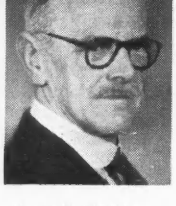
Sir Godfrey Ince

The Minister of Fuel and Power has reappointed **Mr. J. A. Duncan,** B.Sc., of Landican, Birkenhead, as a part-time member of the Merseyside and North Wales Electricity Board.

Mr. T. Golding, O.B.E., A.M.I.E.E., and **Mr. A. H. Hooke** have been elected to the board of W. H. Allen Sons & Co., Ltd., Bedford. Mr. Golding joined the company in 1910 as assistant in the Electrical Department and, subsequently, became chief



Mr. G. A. Cheetham



Mr. J. R. Wilkinson

Mr. E. M. Dakin

Mr. H. M. Hawkswood

Mr. R. A. Rowbottom

Mr. L. F. Ryland

Mr. T. Golding

Mr. A. H. Hooke

electrical designer and, later, manager of the department, which position he has held for the past thirty years. Mr. Hooke, who has been the chief accountant since 1924, had previous connections with the company through its auditors, Deloitte, Plender, Griffiths & Co., on whose staff he served for a number of years before his appointment with W. H. Allen Sons & Co.

Mr. A. R. Key has been appointed vice-president of Johnson, Matthey & Co., Inc., the American associate of Johnson, Matthey & Co., Ltd. He joined the Birmingham branch of the parent company in 1935 and remained there until 1939 when he left to join the Army. In June, 1946, he returned to Birmingham having attained the rank of major. In 1952 he moved to the company's head office in Hatton Garden and later in the year made an extensive tour of the United States. He was transferred to the staff of Johnson, Matthey & Co., Inc., in April, 1953.

Sir Felix Pole has retired from the board of Associated Electrical Industries, Ltd., owing to continued ill-health. From 1921 to 1929 he was general manager of the Great Western Railway, and in the last mentioned year joined A.E.I. as chairman, from which position he resigned in 1945, becoming deputy chairman. In the following year he resigned from the latter position, but continued as a director of the company.

Sir Felix Pole

The Brush Group has announced that **Mr. J. Jones,** managing director of the National Gas & Oil Engine Co., Ltd., has been appointed deputy chairman of that company from 1st January next when he will relinquish his present position and be available to all the companies of the Group in a consultative capacity. **Mr. S. Webster,** at present deputy managing director, will succeed him as managing director of the National Gas & Oil Engine Co.

In view of the increasing importance of Central Africa in electrical development the British Thomson-Houston Co., Ltd., Rugby, has formed a new company, the British Thomson-Houston Co. Central Africa (Private), Ltd., with offices in Salisbury, Bulawayo and N'dola. **Mr. K. C. Ford,** B.Sc., A.M.I.E.E., who has been appointed general manager, is well known in Rhodesian engineering circles, where he has spent a number of years as the B.T.H. Company's regional representative. In addition to Mr. Ford, **Mr. G. R. A. Johnson,** of Johnson & Fletcher, is included on the board of directors.

Following the recent announcement that the British Thomson-Houson Co., Ltd., is establishing a new company in Canada, the British Thomson-Houston Co. (Canada), Ltd., with headquarters in Toronto, we now learn that **Mr. H. Gordon McHaffie,** B.Sc., A.M.I.E.E., has been appointed director and general manager. The company also has a branch office in Montreal and in due course will open other offices in various parts of the Dominion. Mr. McHaffie is well known in Canadian engineering circles, having spent several years in the territory as B.T.H. representative.

The guest speaker at last week's luncheon of the **Batti-Wallahs' Society** was Mr. Andrew Boyle, the biographer of Group Captain G. L. Cheshire, V.C., who was the subject of his address. Mr. Boyle analysed the character of the man and spoke of his war exploits and his great work since the war in helping the maimed. Mr. G. O. Watson (president of the Society) was in the chair and he reminded members that the ladies' night on 16th March next would be held in the jubilee year of the Society. In accordance with custom there will be no luncheon this month.

In view of other business commitments, **Sir George Jessel** will, on 31st December next, relinquish the chairmanship of Parkinson & Cowan, Ltd., and his seat on the board. He will be succeeded as chairman by **Mr. H. P. Barker.**

The Radio and Telecommunication Section of the **Institution of Electrical Engineers** held a soirée on Monday last at the Institution when members were received by Mr. H. Stanesby (chairman of the Section) and Mrs. Stanesby. Among the large gathering were Sir George Nelson, Bt. (President), and Lady Nelson. An interesting programme included the recording of a broadcast, Commonwealth "Twenty Questions," and there were a number of amusing demonstrations and exhibits, including transistors and other semi-conductor devices.

Henry Meadows, Ltd., have appointed **Mr. B. S. Worrall,** A.M.I.E.E., as sales manager, electrical equipment. Mr. Worrall has joined the company after seven years' service with the John Morris Electrical Engineering Co., Ltd., where he was sales director. He received his early training with the British Thomson-Houston Co., Ltd., at Rugby and during the war served in the Royal Navy. Mr. Worrall assumes responsibility for tendering, contracts and development work in connection with the company's range of diesel-electric generating equipment.

Miss Jennifer J. D. Canham, B.Sc.(Eng.), Graduate I.E.E., who joined the Electricity Department, Gold Coast Civil Service, Accra, about three months ago as assistant electrical engineer, has now been appointed consumers' engineer. She suggests to us that "more ladies might be encouraged to venture overseas where there is a desperate shortage of qualified engineers and where the work is most interesting, sometimes amusing and infinitely worth while."

Enfield Cables, Ltd., announces that **Mr. A. B. Maclean** has been appointed manager of its Glasgow branch. Mr. Maclean has been on the staff of Craigpark Electric Cable Co. for the past 24 years, with the exception of 6½ years spent on military service.

Mr. A. B. Maclean

Long - service certificates were presented by Commander P. W. Kent, R.N., chairman of **George Kent, Ltd.,** at the annual ceremony at the Luton works on 18th November. Four members received awards for fifty years' service and twenty-eight certificates marking the completion of twenty-five years.

In reporting in our issue of 18th November the remarks of Mr. G. Leslie Wates, chairman of **Johnson & Phillips, Ltd.,** at the J. & P. Foremen's Association's dinner we attributed to him the statement that "as a result of recent rebuilding they now had a paper cable factory." What he actually said was that the company now had a *very fine* paper cable factory which compared favourably with any in the world. As most readers know, J. & P. have been making paper cables for about sixty years now.

Black & Decker, Ltd., announce the appointment of **Mr. F. E. Hughes** as company secretary, in succession to **Mr. C. W. Johns,** who retired on 30th September last after twenty-five years' service with the company. Mr. Hughes joined the Accounts Department of the company in 1929.

Mr. F. E. Hughes

Presentations were made recently on the occasion of the retirement of **Mr. E. J. Jerrom,** district commercial engineer, Shoreditch, London Elec-

tricity Board. At a gathering at the district offices of his many friends and colleagues in the industry a bookcase and a set of woodworking tools were presented to him by Mr. C. G. Moss, the sub-area manager; a steam iron was also presented to Mrs. Jerrom by Mr. R. H. Rawll, the sub-area commercial officer. Mr. Jerrom joined the Shoreditch Electricity Department forty-five years ago.

Mr. G. R. McCullagh, B.Sc., M.I.E.E., the author of the article on "Modern Techniques in Overhead Line Erection" in this issue, was born in Glenlivet, Banffshire. He received his technical education at King's College, London, and his training at Ladysmith power station, West Cumberland. He was subsequently with Ferguson, Pailin, Ltd., Manchester, and Johnson & Phillips, Ltd., Charlton, in the switchgear drawing office. Later he was with Balfour, Beatty & Co., London, and was assistant to the Electricity Commissioners. Since 1930 he has been with the J. L. Eve Construction Co., being concerned with overhead line work, radar and television towers. Mr. McCullagh recently produced a film on the construction of the 275/380 kV supergrid which has been shown in France, Africa, Australia and America.

Mr. G. R. McCullagh

The eighth annual dinner of the Foremen's Section of the Staff Association of the **Telegraph Construction & Maintenance Co., Ltd.,** and **Submarine Cables, Ltd.,** was held at Pyne's Restaurant, Lewisham Way, London, S.E., on 25th November. Mr. C. Rudd, security officer, presided over a gathering of more than 150 foremen and their guests. In the absence of the chairman, Mr. J. N. Dean, who was abroad visiting the company's interests in Pakistan and Malaya, the directors were represented by Mr. W. F. Randall, managing director of Telcon's Metals Group, Dr. E. W. Smith and Mr. W. Glass (who is also joint managing director of Johnson & Phillips, Ltd.).

Mr. J. Royce

Mr. James Royce has joined Hedin, Ltd. He is to extend their manufacturing range to include furnaces of all types, with particular reference to high temperature work.

The annual dinner and dance of the **I.E.E. Southern Centre** will be held on 15th December at the Polygon Hotel, Southampton. Tickets (members 25s each, students 15s each) can be obtained from Mr. C. G. Brammer, Southern Electricity Board, Magdalen Road, Portsmouth. Applications should be made by 5th December.

OBITUARY

Mr. C. V. Johnson.—The death occurred suddenly on 21st November of Mr. Charles Valentine Johnson, M.I.E.E., consumers' engineer, North West District, North Western Electricity Board. Mr. Johnson, who was sixty-three years of age, was educated at the Birmingham and Midland Institute and Dudley Technical College. He was mains superintendent with the Leicestershire & Warwickshire Electric Power Co. from 1919 to 1934 when he became deputy borough electrical engineer at Rugby. In 1936 he was appointed borough electrical engineer of Eccles, Lancs, and held that position until the nationalization of the electricity supply industry.

Mr. F. W. Purse.—By the death on 24th November of Mr. Frederick W. Purse, M.I.E.E., M.I.Mech.E., there passes one who was very prominent in the electricity supply industry for over thirty years. Mr. Purse was a Bristolian and received his education at the Merchant Venturers' Technical College, Bristol. He entered the service of the Bristol electricity undertaking in 1897 and two years later moved to Bath. In 1901 he was appointed deputy electrical engineer at Warrington, remaining there for about seven years and then going to Watford as chief electrical engineer. This was followed by his taking up a similar position at Carlisle where he stayed from 1913 to 1919. His appointment as chief at West Ham marked the beginning of his most active period in the industry. While in that position he served as president of the Incorporated Municipal Electrical Association, in whose affairs he took a very active interest.

The late Mr. F. W. Purse

Mr. Purse left West Ham in 1929 to become chief engineer to the London and Home Counties Electricity Authority and held that position until his retirement in 1946. While with the J.E.A. he served on the Council of the Institution of Electrical Engineers (1928-31) and was vice-president from 1931 to 1934; he was chairman of the Transmission Section in 1939-40. Mr. Purse's main interest developed in the direction of safe and adequate installation work. He served for many years on the I.E.E. Wiring Rules Committee and was its chairman from 1928 to 1934. He was an enthusiastic supporter of the National Register of Electrical Installation Contractors from its inception; he was a member of the Registration Board and of its Scrutinising Committee and subsequently became honorary director of the Register, a position which he held until his death. We extend our sympathy in her loss to Mrs. Purse, his widow.

Mr. W. E. Bradshaw, A.M.I.E.E., former deputy engineer and general manager of the Islington Borough Council Electricity Department, died on 19th November. Mr. Bradshaw, who retired in 1946, was at Islington for thirty-three years, joining the Department as mains superintendent. Before then he held appointments with the Charing Cross Electricity Supply Co., Ltd., and the Croydon Corporation electricity undertaking.

I.E.E. TEES-SIDE DINNER

The annual dinner of the I.E.E. Tees-side Sub-Centre was held recently at Saltburn. Mr. J. Higson presided and others present included Mr. A. H. Kenyon (chairman, North-Eastern Centre, I.E.E.), Mr. R. Bruce (joint secretary of the North-Eastern Centre), Mr. J. G. Winnard (secretary, Tees-side Sub-Centre), Mr. D. M. Buist (export director, B.E.A.M.A.), Sir Hamish D. MacLaren (vice-president of the I.E.E.) and Mr. J. W. Kerr (joint managing director, Imperial Chemical Industries, Ltd.).

Mr. Buist, who proposed the toast "Tees-side Industries," said that products of the area covered 25 per cent of the total exports of the country. The area had entered the atomic energy field and the development of nuclear energy.

Sir Hamish McLaren also referred to the development of nuclear energy and spoke of the recruitment of engineers and scientists to help in the work.

PRICES OF MATERIALS

In the accompanying table we give the basis prices of the more important materials used in the electrical industry. The figures given are the selling prices and are those quoted on Tuesday last.

ALUMINIUM Ingots	ton £171 os od
COPPER, H.C. Electro	ton £382 os od
Fire Refined 99·70%	ton £381 os od
Fire Refined 99·50%	ton £380 os od
COPPER Tubes ..	lb 3s 7⅞d
Sheet	ton £454 os od
H.C. wire and strip ..	ton £428 15s od
LEAD, English ..	ton £111 5s od
Foreign	ton £110 os od
MERCURY	flask £90 os od
TIN, block (English) ..	ton £773 15s od
ZINC, G.O.B. Foreign	ton £94 15s od
Electrolytic	ton —
BRASS Tubes (solid drawn)	lb 2s 10¾d
Sheet	ton £350 os od
Wire	lb 3s 5½d
PHOSPHOR BRONZE Wire	lb 5s 2⅝d
PLATINUM	oz £32 10s od
RUBBER, No. 1 R.S.S. spot	lb 37⅛—38¼d

VIEWS on the NEWS

By REFLECTOR

WHILE last Friday's Jubilee Dinner of the National and Local Government Officers' Association was a great occasion in the Association's history, I am sure that many of those present felt, as I did, that the toast list was rather long and that one or two of the speeches might have been shorter. No doubt the speakers felt that they were bound to give full measure in appreciation of the invitations they had received. Lord Citrine made a very forceful speech in which he urged the members to remember that they had duties as well as rights. He confessed that in his earlier trade union days he had occasionally referred to "bloated capitalists" but at one meeting, regarding his trade union colleagues, he had resolved to eschew the use of the term and practise "girth control" himself.

* * *

N.A.L.G.O. has an extensive membership in the electricity supply industry and it may be said that there was some sort of electrical element in its origins. Its founder was Herbert (later Sir Herbert) Blain who, although at the time he began his work of organizing municipal employees was on the staff of the town clerk of Liverpool, had become manager of the West Ham tramways by 1905 when the Association was formed. But many readers will remember Blain chiefly for his work with the Underground Railways of London as purchasing agent, operating manager and assistant managing director. While it is perhaps an exaggeration to say, as a special jubilee edition of the Association's journal does, that he laid the foundations of London Transport, there is no doubt that he did a great deal to establish good relations between the Underground group and the public in the period from 1913 to 1924. Blain died in 1942.

* * *

Hitherto, members of the Scottish Gas Board staff have been accommodated in the City Chambers, Glasgow, but they have now been transferred to other premises. The Corporation is resuming occupation but first has to have the premises reconstructed at a cost (according to the *Evening Citizen*) of £20,000 to which has to be added £35,000 for the electrical work. The latter figure seems to be a trifle high for a gas-electric conversion but no doubt it is necessary upon the departure of such tenants.

* * *

Veteran motor cars are always in the news, principally because they can still be operated in "rallies." Old tramcars are not so easily exhibited publicly and seem to end their days as dwellings in remote country spots. If only to prevent this disfigurement of the rural scene the efforts of a new Tramway Museum Society should be supported. But the preservation of these vehicles is also of historic value. The Society has been formed to take over a nucleus of a collection made by the Light Railway Transport League. From a prospectus which has reached me from the hon. secretary of the Society, Mr. J. H. Price, 15, Kingslyn Crescent, Upper Norwood, S.E.19, I see that it is to take over six cars dating from between 1896 and 1912. It is the intention to keep them in order and in the membership form applicants are asked to indicate whether they can undertake voluntary mechanical, electrical and other forms of maintenance. One problem facing the Society is the housing of the cars. They take rather a lot of space and offers of assistance are sought.

* * *

A minor source of irritation to consumers has been removed by the South Eastern Electricity Board's decision to abolish meter rents in the case of flat rate tariffs. I say "minor" because, with the increased use of electricity, the shilling or two a quarter paid for the meter is no longer so significant now as it was before the war, when there were frequent complaints about the "injustice" of meter rents. It was argued that shopkeepers did not charge their customers for the scales used to weigh out the goods bought, so why should the electricity authorities do so for their meters? Nowadays the great majority of consumers are supplied under two-part tariffs in which the cost of the meter is covered by the fixed charge. The South Eastern Board, however, seems still to have a surprisingly large number of flat-rate consumers, for it is reported that no fewer than 100,000 will benefit from the withdrawal of the rents, which will cost the Board £60,000 a year.

* * *

Cable jointing was in its primitive stages eighty years ago and, of course, the joints were in telegraph cables. The *Electrical Review* of 1st December, 1875, reported a discussion on "The Durability of Guttapercha and Indiarubber Joints" at a meeting of the Society of Telegraph Engineers (now the I.E.E.) in which

> "Messrs. Bell and Preece entered into descriptions of the new paraffin joint for street work, which, although not successful up to the present time, had, by the nature of the defects, given sufficient indication that the removal of those defects would result in a valuable joint for the future. The joint is ordinarily made by passing the guttapercha wires through two holes bored in a small oval-shaped piece of wood, the ends of the copper wire are then twisted and soldered; over this is placed a zinc tube, which fits the wooden base, into this melted paraffin is poured and the joint is complete. Joints made eighteen months ago still tested perfect."

The discussion was followed by a paper by Mr. (later Sir) Henry Mance on "Experiments conducted for the purpose of ascertaining whether the teredo borer prefers guttapercha to indiarubber." The idea, of course, was not to meet this animal's dietary tastes but to keep it away if possible. It seemed that indiarubber was less attractive to teredos but rather liked by barnacles.

* * *

There seems to be something appropriate in a note in the *Evening Standard* announcing that "New shelters and strip lighting are planned for Sheerness promenade."

LETTERS TO THE EDITOR

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents.

London's Electricity Supply

WITH reference to Mr. Jesty's remarks in the *Electrical Review* of 18th November (page 991), I thank him for his comments which only emphasize the danger of making generalizations. My comment was perhaps not worded as felicitously as it might have been, but was intended to indicate the preponderance of d.c. supplies up to 1930 in the Central London area covered by this article.

The Brompton & Kensington Co. was, of course, outside this area, and Mr. Jesty will agree that the London Electric Supply Corporation was completely swamped in this part of its supply area by intermingled and wholly d.c. competitors, namely, the Charing Cross, Westminster, and St. James' & Pall Mall Companies. If less than justice has been done it is probably to the City Co. which had both a.c. and d.c. supplies and was competing with the wholly d.c. Charing Cross Co.

The interest in a.c. in 1910 or thereabouts was probably due as much to the introduction of satisfactory types of induction motors as to the metal filament lamp. Many of the early d.c. systems owed their popularity to the satisfactory service which could be obtained from the d.c. motors then available; as is evidenced by otherwise a.c.-minded undertakings having to provide d.c., largely for power users.

London, S.W.1. R. THOMPSTONE.

Butter in Refrigerators

WE were very interested to read the note by "Reflector" on page 981 of your 18th November issue, on the subject of keeping butter at the correct temperature and consistency in refrigerators.

This company has pioneered the inclusion of a butter conditioner in refrigerators manufactured in this country. The Coldrator "Buttador" incorporates a special heating element with its own thermostatic control, in order that up to ½lb of butter may be stored in this special compartment of the refrigerator and still be ready for serving. Housewives will agree that brick-hard butter is a nuisance.

As you will readily understand, a refrigerator is an all-the-year-round necessity since the temperature in a kitchen, whether it be during cold weather or warm, is likely to be higher than the recommended temperature range for the safe storage of food, and butter is naturally susceptible to dust collection unless covered. We therefore feel that "Reflector" may have overlooked this very important point, and by including a butter conditioner with its own heater in our refrigerator we are providing a very real service to the housewife. E. F. FYNN,

Peterborough. *Manager*, Publicity Department, Coldrator Division, Hotpoint Electric Appliance Co., Ltd.

I.E.E. Regulations

IN his interesting letter (*Electrical Review*, 18th November) Mr. R. E. Jennings raises the question of the current to be used for earth loop impedance testing and mentions a 15 to 20 per cent error due to reduced impedance of conduit when tested at 10 A.

While an earth loop impedance as low as about 1 ohm is not required until circuits of 60 A and above are considered (Reg. 406 gives 1·33 ohms max for a 60 A 240 V circuit), where a whole loop of such an impedance or less is tested, in the manner suggested in Reg. 507, but at only 10 A, the voltage developed across it may become comparable with the neutral voltage drop. In a test continued throughout a day on an unloaded 15 A socket outlet in this laboratory, earthed through conduit, having a d.c. earth loop resistance of 0·55 ohm and an a.c. impedance of about 1 ohm, a current of 10 A produced voltages across the loop, varying between 6 and 12 V, the neutral voltage drop varying meanwhile between 0 and 3·5 V. While the associated values of impedance varying between 0·6 ohm and 1·2 ohms would all be satisfactory for a 15 A sub-circuit, there would be doubt when a lower value of impedance was necessary for larger-current circuits and errors also in the earth continuity impedance obtained by difference as suggested in Reg. 507. With the larger voltages required for currents approaching 25 A the variations are much less. The variations will also be less for 10 A if the impedance is greater than 1 ohm, while the magnitude of the error also depends on the range of N & E voltages likely to be met with.

If the impedance of the earth continuity conductor only is required and the procedure of Reg. 508 is followed, there will be no error due to voltage drop in the neutral.

Ipswich. W. E. SAGE, B.SC., D.I.C.

Lamp Quality and Prices

I HAVE read with considerable surprise the note on page 1028 of last week's issue and I am wondering whether Mr. Smith has not been misquoted in this instance.

It is, of course, true that only organizations with first-class machinery and adequate quality control facilities can ensure consistent quality of electric lamps, but such facilities are not restricted to any particular group of companies. My company, although outside the lamp ring, is one of the largest lamp manufacturers in this country and employs fully automatic machinery of its own design and manufacture which is at least equal to any other plant in this country.

This company has held a B.S.I. licence for a number of years and, after full-scale tests, "Atlas" lamps have been approved and used in large quantities by the Ministry of Supply, the Admiralty and other Government Departments, in addition to normal users all over the world.

London, W.C.2. H. H. BALLIN, PH.D., B.SC.(ECON.), F.I.E.S.
Technical Sales Manager,
Atlas Lighting Division,
Thorn Electrical Industries, Ltd.

[Our note, reporting the Liverpool Street Lighting Committee's annual inspection, attributed to Mr. C. C. Smith, the city lighting engineer, the statement that "the high standard of quality control in the manufacture of ring lamps resulted in more consistent service. Provided that they were only about 1d dearer than non-ring lamps they were more economical to use." Mr. Smith has told our reporter that while he does not question the accuracy of the item, he thinks that the following explanation should be given:—"The rigid and careful quality control exercised in the production of the better quality or higher priced lamps has resulted in more consistent service and now that the difference in cost in some cases is down to approximately 1d, the dearer lamp is well worth while."—Editors.]

Electrical Power Engineers

Speeches at Association's Annual Dinner

THE twenty-eighth annual dinner of the Electrical Power Engineers' Association, the representative organization for the professional technical staff of the public electricity supply industry, was held on 25th November. The chair was taken by the president, Councillor J. Parr-Morley.

Mr. Herbert J. Morrison, M.P., proposing the toast of "The Association" recalled his first contact with the organization in Hackney in 1920 (the year of its establishment) and referred appreciatively to the progress it had made since then, to the work of Mr. H. Norton, general secretary, and to the journal the *Electrical Power Engineer,* edited by his Parliamentary colleague, Mr. Arthur Palmer. He also mentioned his later association with the electricity supply industry for which, as Minister of Transport in 1929-31, he was responsible to Parliament.

In view of the importance to industrial productivity and domestic life of "a cheap and abundant supply of electricity" as the statutes expressed it, and of an effective use of electrical power and appliances, the education and training of the modern electrical technologist, he said, must fit him for fulfilling a key role.

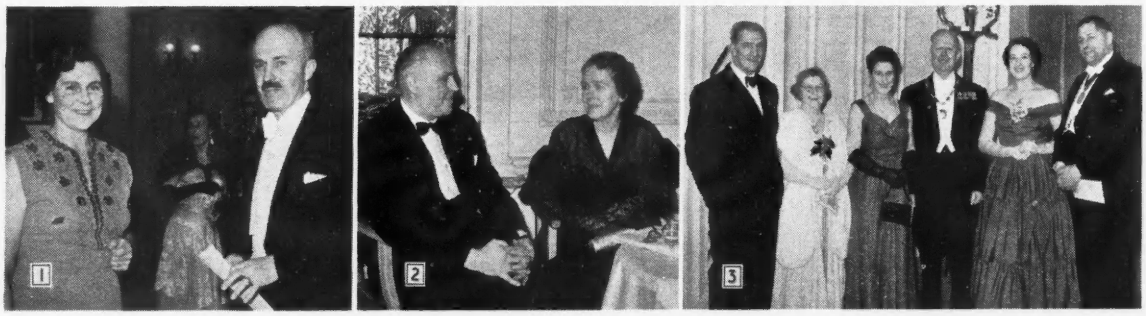
The next stage would be nuclear energy, although coal would be needed for a long time both at home and for export, but coal resources would be less plentiful. Members of the E.P.E.A. were already engaged in the nuclear programme of the Central Electricity Authority, and other possibilities were opened up. There would be repercussions on electrical transmission and distribution, for which the electricity supply industry must be ready. Any undue restriction on its capital expenditure would be unfortunate. The outlook for the industry, and hence for E.P.E.A. members, was promising and healthy.

Responding, the chairman pointed out that electricity was the accepted medium for carrying out the forthcoming industrial revolution through the application of nuclear power. Electrical engineers were very much in the public eye and whether engaged in manufacture or operation they must prove themselves worthy of the duty of giving this country the lead in nuclear engineering as in other engineering. The E.P.E.A., which now had 17,000 members out of a potential of 18,000, would maintain its entirely non-political character; otherwise it might be a menace rather than an asset to the community.

Mr. Herbert Morrison is received by the E.P.E.A. president and Mrs. Parr-Morley

The toast of "The Electricity Supply Industry" was proposed by Sir John Dalton (president, British Electrical Power Convention, 1956), who referred to the late Wilfrid Randell's book "The Romance of Electricity" in support of his view that "all was exciting." He paid a tribute to

1. *Mr. F. Lumby.* **2.** *Mr. and Mrs. Herbert Morrison, Mr. and Mrs. J. Parr-Morley and Mr. W. J. Oswald.* **3.** *Mr. and Mrs. K. C. Newbery.* **4.** *Mr. and Mrs. A. M. F. Palmer.* **5.** *Sir John and Lady Dalton with Mr. H. Norton.* **6.** *The president with Mr. H. J. Randall*



1. *Mr. and Mrs. H. V. Pugh.* **2.** *Mr. and Mrs. F. H. Smethurst.* **3.** *Group including Mr. and Mrs. J. E. Stanton, Alderman R. S. Edwards (Mayor of Wanstead and Woodford) and Mrs. Edwards*

the foresight of the former Electricity Commissioners (to whom he had once acted as legal adviser) whose estimate of a doubling of electricity consumption every ten years had proved correct. From small beginnings the electrical industry had become the greatest in the country and the largest exporters of goods in which it paralleled motor cars. During the past seven years fifty generating stations had been built and the consumption of electricity had grown by two-thirds.

Response was made by Mr. H. J. Randall (chairman, London Electricity Board), who read a message he had received from Sir Winston Churchill. In this Sir Winston expressed pleasure that Councillor Parr-Morley, whom he remembered meeting in the trenches during the first world war and who was now a member of Wanstead and Woodford Borough Council in his own constituency, was this year's president of the E.P.E.A. Mr. Randall reminded his listeners that Mr. Morrison had been invited, twenty years ago, to apply his energies to promoting the spread of electrification as director of the Electrical Development Association.

It became evident many years ago, he continued, that some major reconstruction of the electricity supply industry was needed and the change had been accepted loyally by the staffs. The immense progress that had been made in integration and in technical aspects would not have been possible with over 500 undertakings in isolation. At the same time the control of policy had inevitably passed into the hands of very few people with the accompanying tendency to over-centralization and loss of independence. This made even more complex the appointment of men of ability, vision and courage for high positions. The Association should endeavour to provide such men.

Thanks to the permanent staff of the Association and honorary officials with a tribute to the fortitude and patience of their wives was voiced by the chairman, who mentioned especially the debt due to Mr. F. H. Smethurst as the now traditional organizer of the function.

N.A.L.G.O. Jubilee Dinner

LAST Friday the National and Local Government Officers' Association, which includes in its membership a large number of people on the administrative and clerical side of the electricity supply industry, held a dinner to celebrate its golden jubilee. It was at the Guildhall, London, and the chairman was the president of N.A.L.G.O., Mr. P. H. Harrold, O.B.E., who is town clerk of Hampstead.

Mr. Duncan Sandys, Minister of Housing and Local Government, proposed the toast of the Association. He said that the presence of so many distinguished guests was testimony to the importance attached to N.A.L.G.O. with its quarter of a million members. During the past 50 years there had been continuous growth in this country's national and local government and many countries had admired and imitated the British system.

In the course of his response, Mr. Harrold said that their satisfaction at the achievements of the past half century was accompanied by that divine dissatisfaction which was the urge to progress. During that period, as conditions of employment had improved through the efforts of the Association, there had been a corresponding change in the outlook, quality and morale of the service.

The toast of " Local Government and Public Services " was proposed by Mr. C. R. Attlee, O.M., C.H., Leader of H.M. Opposition. He said that local government in this country was a very ancient thing and had preceded national government. There could be no good citizenship at the centre without good local citizenship. Referring to the extension of national control of services he said that when he entered upon local government many years ago the electricity undertaking was their pride; now all such undertakings had been handed over to Lord Citrine.

The first response to the toast was by Mr. Norman Prichard, M.Sc., J.P., chairman of the London County Council, and Lord Citrine also replied. Mentioning that he had been a trade unionist for 44 years, Lord Citrine said that national boards were a comparatively new manifestation. As chairman of the Central Electricity Authority he regarded himself as a humble instrument or trustee, not only for Parliament and the public, but also for the people employed in the industry. In the nationalization Acts Parliament for the first time made full recognition of trade union membership, giving the right of joint consultation. Rights must be accompanied by a recognition of responsibility; public service gave people an opportunity of giving of their best to the community in an organized way. Trade union leaders must lead even to the extent of pursuing courses which they knew to be right in the face of opposition from their rank and file. In the next few months we were going to see whether trade union leaders would resist the pressure of their members' demands in the country's own interest and in that of trade unionists themselves.

The president thanked the Lord Mayor, Sheriffs and Corporation of London for allowing them the use of the Guildhall for the dinner and the health of the guests was proposed by Sir Geoffrey Hutchinson, M.C., T.D., Q.C. (hon. member of N.A.L.G.O.) and acknowledged by Mr. Clement Davies, Q.C., Leader of the Parliamentary Liberal Party.

Faraday Lecture

COAL MINING ELECTRICALLY

Mr. B. L. Metcalf, Chief Engineer, National Coal Board, first delivered the 1955–56 Faraday Lecture at Cardiff on 1st December

BY contrasting conditions in coal mines at the time of Sir Humphrey Davy's invention of the safety lamp with those obtaining to-day, Mr. B. L. Metcalf (chief engineer, National Coal Board) justified the claim made in his Faraday Lecture, first delivered at Cardiff on 1st December, that technical and social progress went hand in hand.

No single discovery in engineering, he said, had contributed more to social progress than had Faraday's discovery of the principle of electromagnetic induction in 1831. Faraday, who was Davy's pupil, was regarded as an authority on safety in mines and was called in to report on an explosion at Haswell (Durham) Colliery in 1844, seemingly due to defective lighting equipment.

The first recorded use of electricity in a coal mine was in Scotland in 1881. Now 4,000 million kWh per annum was used together with steam to produce about 220 million tons of coal by the mining industry of Great Britain, probably the largest in the world to operate under one control. Every working day more than 500,000 men had to be taken down and up 2,000 shafts and half that number transported to the coal face and back.

A typical large colliery with an output of a million tons a year might have 3,600 h.p. of electric motors and the capital costs of the electrical equipment would amount to £750,000, of which over £400,000 was for underground working. The services included ventilation, coal preparation, winders, distribution, lighting, coal cutting and conveying, shaft cables and locomotives.

Tests for certification of safety in inflammable atmospheres were started at Sheffield University in 1922 and at the Mines Department's Buxton station in 1931. Sparks from inductive telephone and signalling circuits were found in 1913 to ignite fire damp and air mixtures and in 1917 the Home Office undertook to certify all bells and relays that were "intrinsically safe." Flame propagation started at about 5½ per cent methane in the air, but inflammability ceased at 13 per cent.

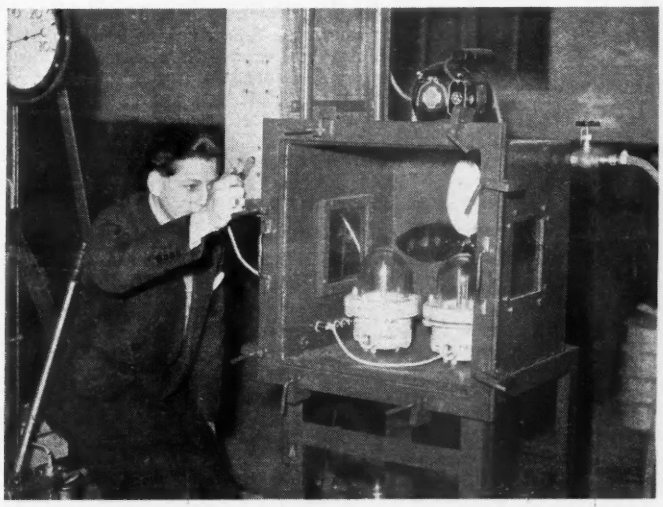
Tough rubber sheathed trailing cable with three power cores, a pilot core and an earth wire were used for all portable coal-face equipment. Earth-leakage protection cleared faults in much less than 10 millisec without visible flash.

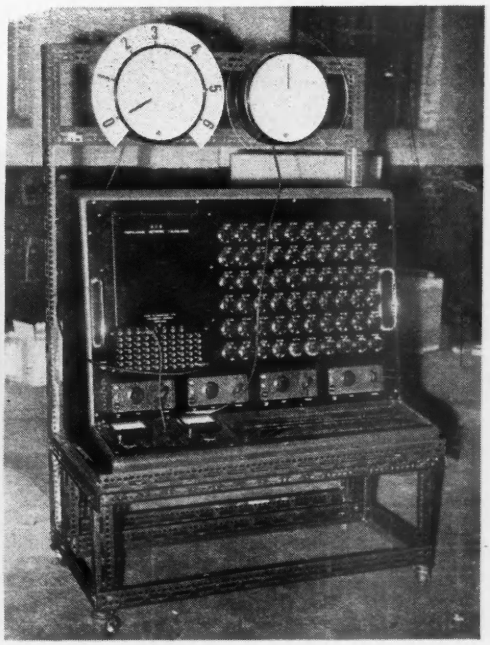
Magnetic testing of the condition of winding ropes was under consideration. Such tests were based on the theory that any flaws would result in a change in the magnetic circuit, thus causing movement of a pen on a chart. Experiments were also being carried out with a new instrument which measured the kinetic stresses in ropes produced by acceleration and deceleration; a continuous high-frequency signal was transmitted up the rope to the surface where a receiving unit interpreted the signals.

Electricity, in conjunction with dust suppression by water spraying, also protected the health of miners, particularly as regards pulmonary diseases. Mobile X-ray units fitted with automatic processing devices provided regular examination for all underground workers. Electrical treatment was also given in cases of severe rheumatism.

The total energy in the methane discharged from British pits was about two-fifths of that from all the gasworks in the country. From a large gassy mine the quantity might

Left: Explosion chamber for demonstrating flameproof equipment. Right: Ventilation network calculator



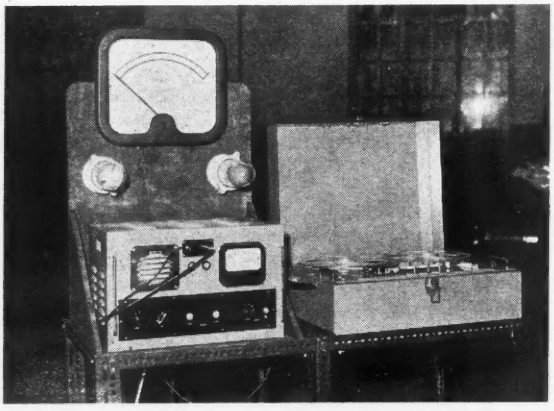


be over 3,000 cu ft/min. Bore holes in a virgin seam, however, yielded little gas, as the coal had to be fissured. An exception was the Point of Ayr colliery in North Wales where bore holes at any point liberated gas at pressures up to 300 lb/sq in. A power station (the only one running on natural gas in Britain) containing five 750 h.p. dual-fuel engine sets had just been put into service there to supply the whole colliery with power and in addition to export gas to the Area Gas Board. The method adopted did not substantially differ from that suggested by Faraday in his Haswell report.

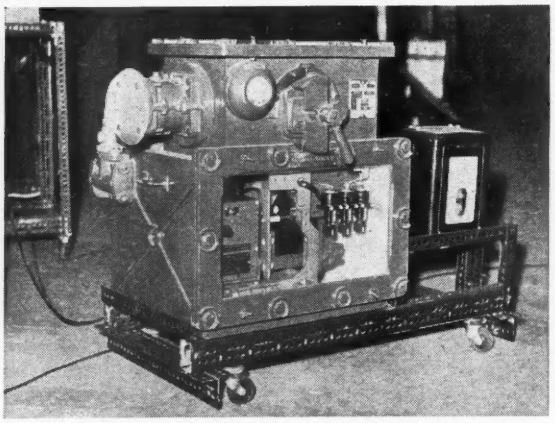
In Staffordshire a gas turbine had been installed to determine the weakest mixture in air that would sustain combustion. Mine air containing 0·5 per cent methane required to be mixed with drained methane to increase the proportion to $1\frac{1}{2}$ to 2 per cent. At other mines methane was being drained for burning under colliery boilers or compressing into bottles for laboratories and driving lorries.

Ventilation problems were solved by means of an electrical analogue in which air pressure drop was reproduced by reference to Kirchhoff's law relating voltage to ohmic resistance. For most operations conventional telephones were satisfactory, except for locomotives which, being either diesel or battery driven (apart from one pantograph unit), were isolated as regards communications.

Wireless transmission could not be applied below ground. " Walkie-talkie " sets, which on the surface could cover two miles or more, were good for only 30 to 40 yd along mine roadways, where the energy transmitted was quickly absorbed by the walls, unless the roadways contained electrical conductors, the effective distance then being up to 1,000 yd. The use of radio links to conductors was therefore being investigated and a portable set had been developed; its operating frequency was low, between 100 and 200 kc/s, frequency-modulated.



Equipment for recording shaft winding signals



Flameproofed motor starter, with non-flameproof equipment for comparison

Two major technical advances had led to greatly improved lighting performance—first, the development of higher voltage and more efficient batteries and, secondly, the substitution of krypton-filled for argon-filled bulbs. Krypton gas permitted operation of filaments at a higher temperature, giving 40 to 50 lumens from a miner's lamp having a bulb little larger than that of a motor car's side lights. Mains lighting on the face in safety lamp mines had been permissible only since 1934 and subsequent experience had proved it to be practicable.

The mine shaft might easily become a bottleneck in striving for increased production with greater safety. A main objective was to achieve a fully automatic and foolproof system of electric winding. The modern trend was towards the lift principle, depending upon the friction between a driving pulley and one or more ropes to provide lifting power, motors and pulleys being mounted in the headgear. Among the various devices for ensuring safety with speed of operation was an automatic shaft guard to prevent the starting of the engine when some object was projecting from the cage. This was based upon the use of a photo-electric cell to protect an area of about 6ft wide by 4ft high by means of a rotating shutter and parabolic reflectors that scanned the area 50 times a second. Any object remaining there for more than $\frac{1}{50}$ sec interrupted the light beam causing a pulse in the receiving device which operated a relay. This was the first of its kind for colliery use and had not yet been finally developed. The working of the wide variety of electrically operated machinery in collieries was illustrated by numerous films and physical demonstrations with a running commentary by the lecturer.

Atomic Information

ONE of the methods used by the United Kingdom Atomic Energy Authority to make atomic energy information as widely available as possible is to supply unclassified documents to certain libraries which are designated depository libraries. Until recently there were only two such libraries in the United Kingdom, the Science Museum Library in London and the Sheffield Central Library. In view of the increasing demand for the documents, particularly from industry, the following are now included in the depository library scheme:—The Central Library, Birmingham; the Mitchell Library, Glasgow; the Central Library, Liverpool; the Central Library, Manchester; and the Central Library, Newcastle. Documents deposited in these libraries are freely available to the public, and the libraries have agreed to supply photostat copies at their usual rates on request. The documents are also sent to the Copyright Libraries and to the Patent Office Library, and some are on sale through H.M. Stationery Office.

A monthly list of Authority documents available to the public in depository libraries (including those on sale through H.M. Stationery Office) is to be issued from the Atomic Energy Research Establishment. This list will also include papers published in the scientific and technical Press, and an indication of whether reprints of these papers are available. Requests to be put on the mailing list should be sent to the Librarian, A.E.R.E., Harwell.

Following recent relaxations in the security grading of much atomic energy information, the Authority is undertaking a review of its hitherto security classified documents to see which of them can be published in the scientific and technical Press or made available in report form.

ALUMINIUM PRODUCTION

New Heavy Extrusion Plant at Latchford

SINCE 1911 the British Aluminium Co., Ltd., has been engaged in the production of aluminium and aluminium alloy extrusions, and for many years this branch of its activities has been concentrated at its Warrington factory which is also a sheet and strip rolling mill. Presses ranging in capacity from 600 tons to 2,500 tons have constituted the extrusion capacity hitherto, but developments in the aluminium alloy structural, marine and transport fields involve heavier presses to meet the demand for larger sections in strong and medium strength alloys for supply either in the " as extruded " condition or subsequently heat treated. Foreseeing these developments, the company acquired, under war reparations arrangements, 5,000 and 3,500 ton piercing presses of Schloemann manufacture and heavy section stretching plant. These two press units form the basis of a new extrusion scheme at Latchford.

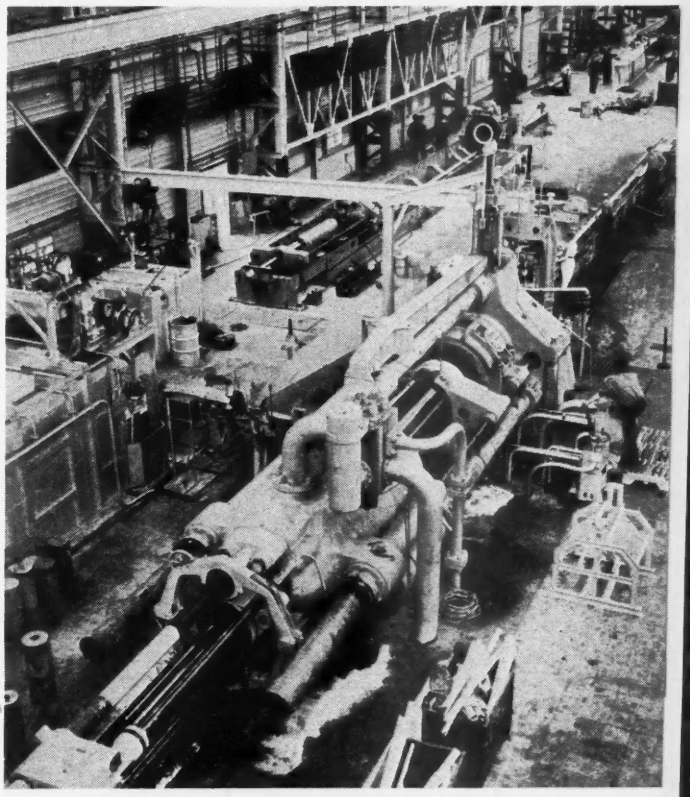
The new extrusion factory, with its associated subsidiary buildings, occupies an area of 1·53 acres. The site is to the north-west of the parent works and although the haul for cast billets prepared in the parent remelt shop and for returning process scrap is kept to the minimum, ample space exists for expansion. The production plant is in a single bay of 106ft span and 550ft length, while the tool-room forms an annex 40ft wide and 100ft long on the west side. The building itself is a steel structure double-skinned in corrugated aluminium sheeting.

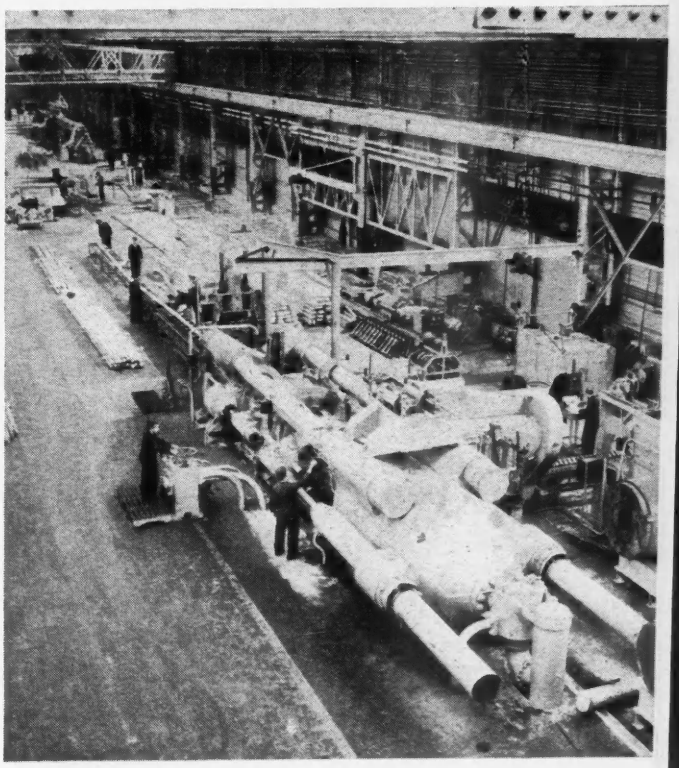
Metal is cast into extrusion billets from two fixed-hearth, oil-fired melting furnaces in the parent factory remelt shop, the furnaces having bath capacities of 8 and 5 tons respectively. These furnaces serve two screw type semi-continuous casting machines having a range of electrical speed control from 0 to 15in/min. Billets ranging in diameter from 10in to 16in are produced on these machines, which will ultimately handle cast stock up to 20in diameter.

The billets are next sawn to length on a Noble & Lund 60in " Flui-feed " saw which will accommodate the full range of billet sizes. For certain alloys and end products the billets are then scalped in a machine by Wirth, of Germany, in which billets up to 37½in length and 16½in diameter can be machined to a depth of ⅜in in a single run at cutting speeds up to 2,920ft/min and feed speeds ranging from 40 to 60in/min. The machine is driven by a 100 h.p. two-speed motor. Cast billets sawn to length and scalped where necessary are then transported to the extrusion factory.

Extrusion Plant

The electric reheating furnace associated with each extrusion press is of G.W.B. manufacture and is of the chain conveyor type. Rated at 715 kW, each is equipped with three-zone temperature control and forced air circulation. The chamber width of 9ft accommodates two rows of billets on two sets of conveyor chains through the





Above is the 3,500 tons extrusion press and (below) general view of the 5,000 ton extrusion press

furnace, which discharge each billet on to a transverse roller conveyor feeding the billet handling gear associated with each press.

Both the 5,000 ton and the 3,500 ton presses are served from a common hydraulic installation operating at 3,600 lb/sq in. The hydraulic medium is water with the addition of a corrosion inhibitor and the accumulator system includes thirteen 560 gal capacity steel bottles of which eleven are under air pressure and two are air/water bottles. The hydraulic system is supplied from a total of five positive displacement fixed delivery three-throw pumps having a total capacity of 450 gal/min and a total pump horse-power exceeding 2,000. The presses are served by a 25 ton electric overhead travelling crane of Morris manufacture with a 5 ton auxiliary hoist.

The 5,000 ton Schloemann extrusion press is a four-column unit weighing 350 tons, the main ram of which is 54in in diameter and has a maximum stroke of 100in. Container heating is by induction, the conductors forming an integral part of the container mass. Die sealing is by hydraulic rams operating under full system pressure, while the press is equipped with a run-out table 36ft long beyond which may be positioned a power driven coiler for the drum coiling of extruded tube. The press is capable of accepting billets ranging from 10in to 20in in diameter and up to 45in long.

The 3,500 ton press incorporates a piercing ram of 500 tons thrust with the main ram capable of exerting 3,000 tons pressure. When the press is not engaged on piercing operations, however, the total pressure of 3,500 tons can be exerted. This press, which weighs 250 tons, is of the three-column type and has a main ram diameter of 54¼in and a maximum stroke of 83in. The press is capable of accepting billets ranging from 8in to 12in diameter. Both presses are equipped for the automatic handling of billets and pressure plates and are furnished with extrusion speed indication and die heating facilities mounted adjacent to the production plant.

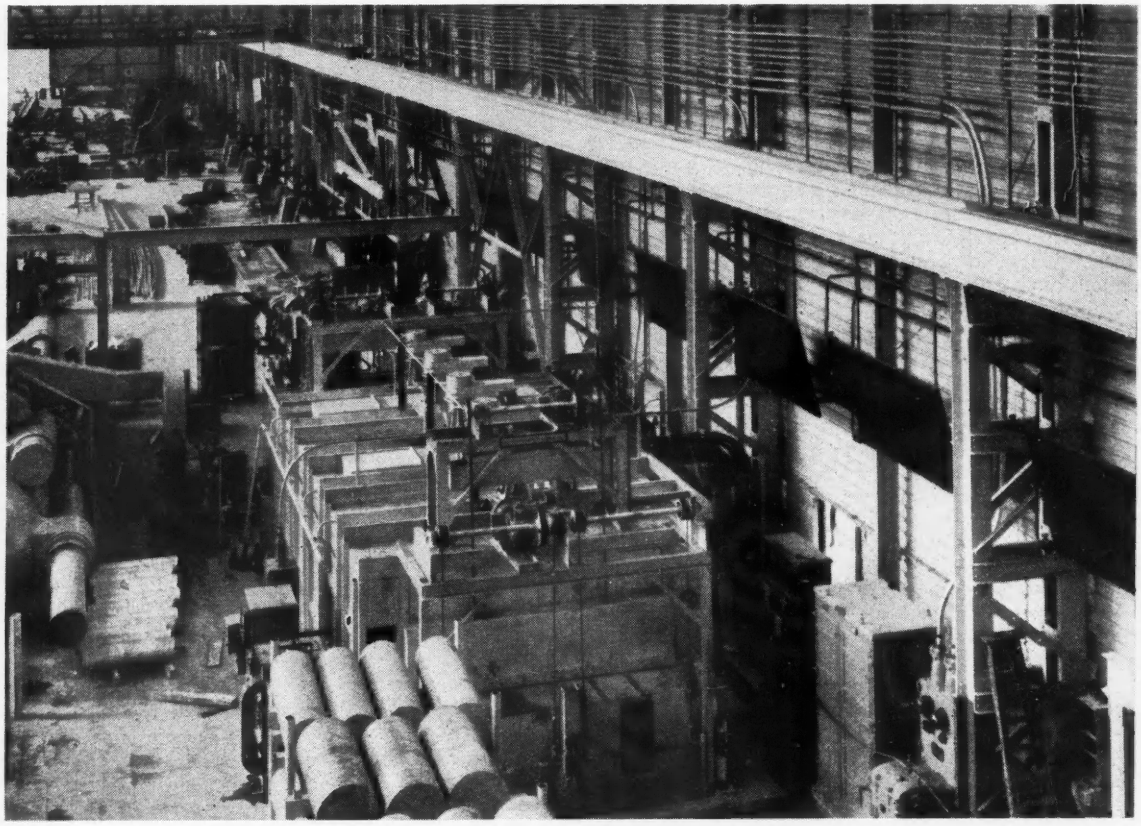
Heat Treatment

The section heat treatment furnace supplied by Birlec, Ltd., is of the horizontal type rated at 500 kW and is capable of accepting a maximum section length of 60ft. It is designed for axial air flow with a 40/80 h.p. circulating fan. Loaded skips are charged into and discharged from the furnace by means of electrical " go-getter " equipment which quickly and automatically locates the hot charge extracted from the furnace on to rails for rapid immersion in the quenching water. The overall length of the complete installation incorporating both furnace and quench tank is 160ft and the furnace is one of the longest horizontal section heat treatment units in the country. The furnace is designed for both solution and precipitation heat treatment duty.

The section stretching plant comprises five machines with maximum pulls of 30, 100, 150, 200, and 585 tons respectively. The 100 ton, 150 ton and 585 ton stretchers are each equipped with facilities for de-twisting sections under tension and, furthermore, the 585 ton unit has a potential design capacity of 700 tons when equipped with a self-contained hydraulic supply at 300 atm.

In addition to section saws, the finishing equipment includes 30 and 40 h.p. multi-roll straightening machines, a Henry Berry 100 ton horizontal bending and straighten-

The east side of the factory during final stages of construction. The smaller amount of supporting necessary for aluminium sheathed cables is well illustrated on the furnace cable terminations



ing press, together with profile correcting machines, etc. The finishing plant and warehouse are served by two 7½ ton e.o.t. cranes of 100ft span supplied by S. H. Heywood & Co., Ltd.

At present the extrusion plant is capable of producing a wide range of extruded sections, including all those covered by B.S. 1161. Sections in the fully-heat-treated condition can be supplied up to 55ft finished length, while non-heat-treated sections up to a maximum of 75ft can be produced.

Electrical Installation

With the increasing attention now being directed to the use of aluminium conductors for insulated cables in addition to the use of aluminium for sheathing, the cable installation is of particular interest. Although there is nothing novel in the use of aluminium for both conductors and sheaths, this constitutes the first large-scale installation in this country in which aluminium has extensively replaced the conventional copper and lead.

Except for the largest power cables aluminium has been used throughout the installation as conductor material both of rubber insulated wiring cables and also of paper insulated cables of all types, both medium and high voltage. Where sheathed cables are used the sheaths also are of aluminium, the only exception here being some 1·0"sq in cables feeding the main medium voltage substation switchboard from the transformers.

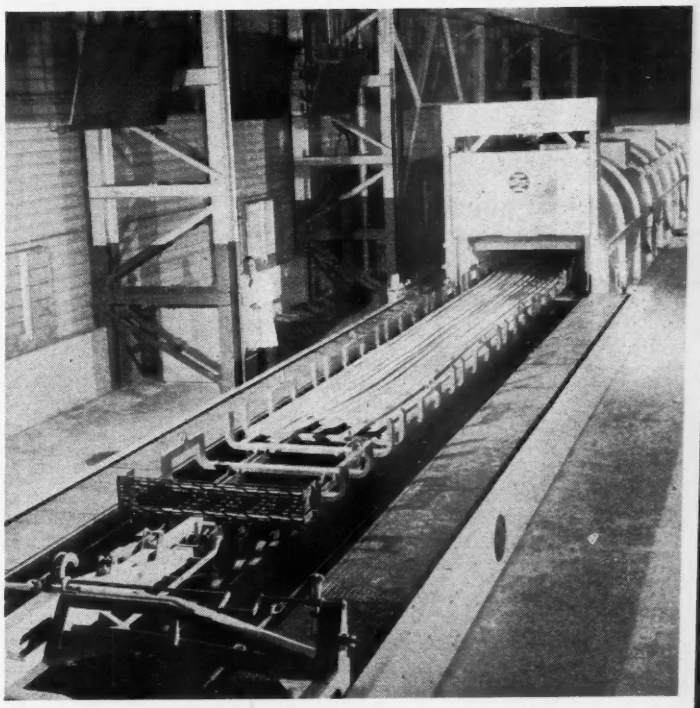
The results show that an all-aluminium cable scheme, including both underground feeder systems and factory or building wiring, offers a significant saving in cost as against a cable installation embodying traditional materials. Experience on the Latchford scheme has also shown that a completely satisfactory installation can be obtained without introducing any significant changes in normal installation procedure. Generally speaking, aluminium conductor/aluminium sheath cables were found no more difficult to handle than copper/lead cables, although it must be recognized that, with underground feeders directly buried in the soil, care is necessary to ensure that the special servings are not damaged.

The installation contains approximately 3,000 yd of all-aluminium paper-insulated cable to B.S. 480, and 14,300 yd of aluminium conductor v.r.i. or p.v.c. insulated cable to B.S. 7 or B.S. 2004, of which 4,500 yd is aluminium sheathed, the remainder being taped and braided.

In addition to the foregoing, some 1,000 yd of three-core 0·4 to 0·6 sq in paper-insulated aluminium-sheathed cable with copper conductors has been installed. The decision to employ copper cores in this instance was taken because the equivalent conductor size in aluminium would have fallen into the range of 0·6 to 1·0 sq in; in the absence of experience some apprehension was felt regarding the handling of such sizes.

For the underground cable, buried direct, the sheath serving consists of overlapped tapes in the order of p.v.c., rubber, p.v.c., hessian. There are bitumen applications over the sheath and over the hessian, which give a robust finish with excellent water impermeability, and can be relied upon to give complete corrosion protection. The aluminium sheath itself is adequate protection against mechanical damage without the addition of armouring. Within the building, since the atmosphere is dry and free from corrosive fumes, no sheath protection was deemed necessary.

On the basis of 1954 costs, when contracts were placed, the aluminium cable installation showed a total saving exceeding 6 per cent compared with the copper/lead alternative, while in the case of certain individual cable sizes savings up to 25 per cent could be shown. Subsequently the price difference in favour of aluminium has widened and cost savings resulting from the substitution of aluminium conductor/aluminium sheath cables can be claimed which, to-day, in certain cases, exceed 33 per cent.



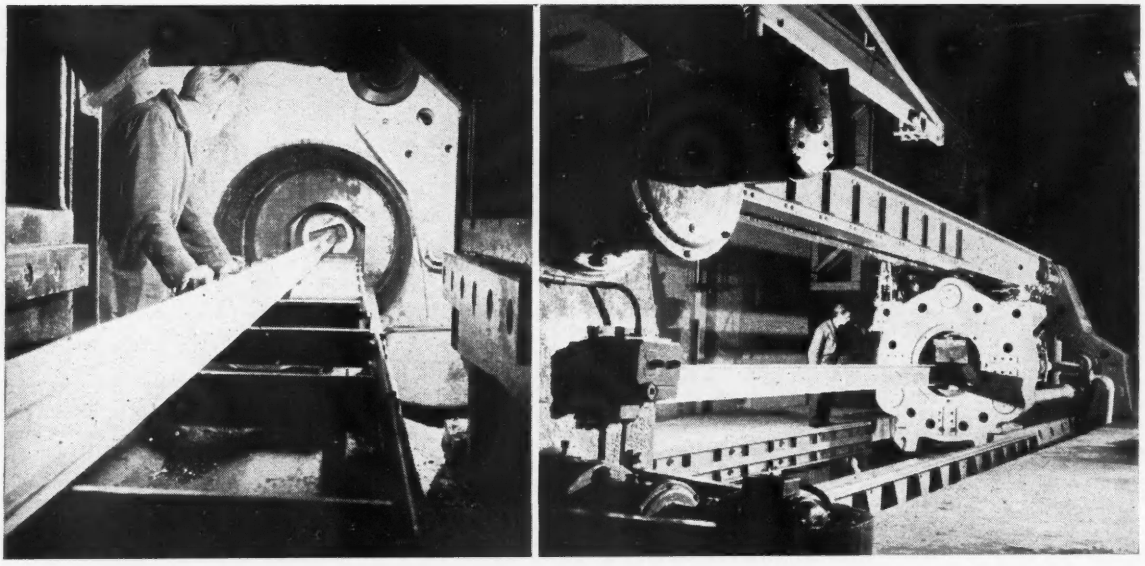
Birlec furnace for precipitation and solution treatment with quenching tank in foreground

The maximum economic advantage is found in those cables having the largest conductor size and, in considering the overall cost difference of 6 per cent based on 1954 prices, it is important to bear in mind that this was achieved in a factory installation following the usual pattern in which small cables predominated and larger sizes which showed to maximum economic advantage represented a relatively small proportion of the total cable installed.

Power service is established over a 6 kV ring main from an Area Board substation within the works boundary. This ring interconnects the old parent factory substation with the new substation adjacent to the extrusion plant on the east side. This new substation in its present stage of development contains three 1,500 kVA, 6 kV/415 V transformers, together with the h.v. and m.v. switchgear, and from this point a 6 kV service to the h.v. hydraulic pump motors is taken underground. The aluminium conductor/aluminium sheath cables for the 6 kV service were furnished with a protective serving and buried direct.

The m.v. cables entering the factory from the substation have bare aluminium sheaths and pass into the building in an upward direction to the main cable racks above crane rail level along the east side. The feeder cables drop vertically to terminal points on the east side, or cross the roof trusses to similar terminal points on the west side. Intermediate and final sub-circuit cabling is accommodated on racks along the walls of the building approximately 8ft from the floor. Paper insulated cables with individual loadings from 100 to 1,100 A are employed for all outgoing circuits from the substation and all main distribution to plant of 60 A three-phase rating and above.

The smaller rubber insulated cables are used for all single-phase circuit distribution and three-phase sub-circuit wiring for machines, lighting, etc. The larger single



Left: Large extruded section emerging from the die of the press and (right) the 585 ton stretching machine with de-twisting heads

aluminium conductor rubber cables are used on single- and three-phase 415 V circuits for terminations at control panels for heavy-current-consuming furnace equipment. All paper insulated cables are fixed with aluminium alloy claw type cleats and aluminium saddles are used for the aluminium sheathed v.r.i. cables.

While aluminium sheaths result in a more rigid cable than lead sheaths conventional installation methods proved quite successful. Supports for interior cabling were erected at 4ft 2in spacing, a distance which it was subsequently found could have been increased. The main difference in the use of aluminium as opposed to lead sheathed cables was that more time was necessary to straighten the cables for cleating and to form bends and offsets neatly, but this was counterbalanced by the advantage of reduced weight. Although the size of multi-core all-aluminium cable was limited to 0·3 sq in, the installation demonstrated that substantially larger power cables could be satisfactorily installed using conventional practice.

The lighting in the main building comprises triple lamp 5ft fluorescent fittings at a mounting height of 30ft and at 25ft centres. The reflectors are of 20 s.w.g. anodized aluminium alloy, and "New Warm White" lamps were installed throughout with a resultant initial light intensity at the working plane of 11 lumens/sq ft in the main building, 18 lumens/sq ft in the warehouse, and 20 lumens/sq ft in the toolroom.

A trunking installation was used for lighting distribution, the fittings themselves being suspended from the trunking by hooks with a plug and socket connection at each lighting source to facilitate removal and interchange. Lighting wiring comprised 7/·029in single-core, aluminium v.r.i. final sub-circuit wiring controlled from wall mounted switchgear served by 7/·029in four-core aluminium conductor/aluminium sheathed cable.

The power and lighting installation was carried out by Troughton & Young, Ltd., with cables supplied by British Insulated Callender's Cables, Ltd. All jointing on paper insulated power cabling was carried out by British Insulated Callender's Construction Co., Ltd.

Measuring Vibrations

IN a paper delivered before the London Graduates' and Students' Section of the Institution of Electrical Engineers on 22nd November, Mr. D. E. Mullinger discussed mechanical vibrations in relation to methods of electrical measuring, recording and analysis. Transducers with electronic equipment were, he said, the commonest vibration-measuring instruments; they allowed information to be transmitted, amplified, integrated or differentiated with relative ease. A seismic or spring-mass mechanical system was used with either passive transducers, which caused a change of resistance or reactance and had a wide frequency range, or with more simple active inducers, which generated a voltage. Among the numerous passive transducers inductance types were more common than the capacitance pattern. Present practice was to employ a carrier frequency of 2 kc/s which limited measurements to vibrations below 500 c/s.

Active transducers were popular for field measurements; although unlike the passive types their response did not extend to static conditions. Of the two varieties, the moving-coil and the piezo-electric, the former produced an output voltage proportional to the velocity of vibration and was associated with integrating or differentiating networks to obtain the displacement or acceleration; it was robust and gave a large output and could be used up to the 1 kc/s region. Piezo-electric transducers had a wider frequency range, 20 c/s to 5 kc/s being common with barium-titanate accelerometers; they were light but could withstand severe shocks; they normally required amplifiers of high input impedance.

Magnetic tape recording, compared with galvanometers and c.r. oscillographs, permitted a higher measuring frequency and an easy reproduction of the vibration signal (requisite for analysis) and the records needed no processing.

A vibration laboratory needed essentially a means of producing controlled vibrations. Moving-coil vibrators (similar in principle to a loudspeaker) could produce thrusts up to 12,000 lb and frequency changes up to 10 kc/s. A component should undergo two tests—a resonance search and a life test.

Progress in Load-Curve Analysis

Attempts to Relate Charges to Costs

By P. SCHILLER, Dipl.Ing., M.I.E.E.

THE complexities of electricity supply costing have been the subject of many papers and articles, and much discussion has been devoted to one of the central problems, namely, the treatment of capacity costs. Greatly simplified, the basic costing problem can be defined as, first, how to find out in what measure individual cost items are related respectively to energy, demand and number of consumers, and, secondly, how to allocate them correctly to the consumer classes concerned. The essence of the second part of the problem is that while the energy consumption and number of consumers are readily available for each class, the class load curves which should provide the basis for allocating the demand-related costs are not.

Attempts have long been made to derive such load curves, and some of the methods used have been reviewed recently.[1] The most common rest either on the comparison by graphic means of load curves of systems supplying different (very large or very small) proportions of particular consumer classes, or on the selection of samples of consumers and synthesis of load records taken. More recently, the statistical method known as multiple-regression has been successfully used.

Multiple-Regression Analysis

Let us consider the demand on a comprehensive supply system at a certain clock time of a winter day. It can be regarded either as the sum of the demands which the individual consumer classes concerned make at this particular time, or as composed of several types of load, such as lighting, space heating, power, etc. Taking the latter alternative first, it is clear that the demand of the lighting load will be affected by the daylight illumination at the particular time, and that of the space-heating load mainly by the air temperature.

Suppose now that for a compact supply system a table is prepared giving for each of the Mondays of November and December of one year, and January and February of the following year (omitting holidays) the demand at 4.30-5 p.m., together with the average daylight illumination for this half-hour and the temperature. It can then be assumed that if there are days with equal illumination but different temperature, the difference in the corresponding demand values is caused mainly by the different temperature; and, similarly, differences in demand between days with the same temperature but different illumination can be associated with the latter. In fact, if sufficient numbers of the two kinds of day were available, one could thus establish the approximate relationship between daylight illumination and demand, and temperature and demand, and in further consequence the contributions of the lighting load and of the space-heating load to the system demand at the particular weekday and time for conditions of complete darkness and low temperature.

Unfortunately, the number of suitable days would be found insufficient, for in most cases both illumination and temperature will vary in the same or opposite direction, and at different rates. If, however, the effect of each of the two "independent" variables (the demand being the dependent variable) follows, or can be assumed approximately to follow, on the average, a definite mathematical law, their individual relationships can be separated out by multiple-regression analysis.

The simplest law of this kind is direct proportionality, in which case for each of the days in question an equation of the following type can be written:—

$$d = a + b_i i + b_t t$$

where d represents the system demand at 4.30-5 p.m.; a is a constant, representing the demands which are independent of the variables under consideration, and, it can be assumed, will not vary much, at the time of day in question, between one Monday and another; b_i and b_t are coefficients, i being the daylight illumination in lumens per sq ft and t the temperature. The constant, a, and the two coefficients are then determined by the method of least squares (similar to the fitting of a straight line if there is only a single independent variable).

In the present case, the coefficients will come out negative, because both lighting and space-heating demand fall as illumination or temperature increases, respectively; moreover, experience has shown that the illumination relationship is more appropriately expressed by using the logarithm of i. The resulting multiple-regression equation can be used for estimating (or forecasting) the system demand for given values of i and t. Further, the shares of the lighting and space-heating load in the system demand can be estimated individually.*

In this country, attention was first drawn to this application of multiple regression some ten years ago,[2] and, with appropriate refinements, it has since become a routine tool in system operation. By making similar computations for each half-hour of the day, complete daily load curves of the daylight-related lighting load and of the space-heating load can be developed for given conditions.†

If, however, we look upon the system demand at a particular day and time, not as an aggregate of a more or less constant load and variable lighting and space-heating components, but as made up of the demands of several classes of consumers, multiple-regression analysis might also be able to separate these demands out. If there were only three classes of consumers on the system, the above equation would read:—

$$d = a + b_c x_c + b_d x_d + b_i x_i$$

b_c, b_d, and b_i again being coefficients, whereas x_c, x_d and x_i now represent some suitable measure of the relative magnitude of three assumed component loads, or classes of consumers, irrespective of their demands at various times of day. If x_c be assumed to embrace the classes of commercial and public lighting consumers, x_d the domestic and farm classes, and x_i the industrial and traction classes,

* As the coefficients are negative, the actual shares result in this case as the difference between their highest possible values and the corresponding terms of the equation.

† It will be recognized that the method will in fact only measure the portion of the total lighting load which is responsive to changes in daylight illumination, in contrast to that which is independent of such changes. Furthermore, it is of course an approximation to view the space-heating load at a particular time as being only responsive to the air temperature at that time; owing to the heat conservation of buildings, antecedent conditions have some effect, and also weather factors other than temperature. The effect of wind, for instance, can be considered by including its force as an additional variable.

"a" can be omitted. In what follows, reference will be made to these three principal classes of consumers only, disregarding that each has been merged with a minor class. The relative magnitude of a class of consumers can be expressed by its annual kWh consumption, or, seen from the supply side, the annual kWh sales to it.

However, as regression analysis presupposes the availability of a reasonably large number of different sets of associated values of the variables concerned, and for a given system x_c, x_d, and x_i are not variable, it requires in this case a plurality of systems with varying proportions of the three (combined) classes in question; and instead of a plurality of days, one will now select only one or two characteristic ones, such as a very cold winter day or a warm summer day.

Suppose daily load curves are available for numerous sections of a large supply system, each section containing the three classes of consumers in proportions differing between sections. If the relative constitution of each class load as to lighting, heating, power, etc., does not vary excessively between sections, the load characteristics (more specifically, the general shape of daily load curves and the annual load factor) of each class can be expected to be fairly similar for all sections; and for a particular class and day, all the ordinates of the load curves of the various sections will then be, on the whole, directly proportional to the respective annual kWh sales to this class. On the other hand, the shape of the corresponding aggregate load curve of each section will vary according to the relative kWh sales to the assumed three classes of consumers.

We now look again at one particular half-hour of a dark and cold day, and write the last equation, with the constant term omitted:—

$$d = b_c x_c + b_d x_d + b_i x_i$$

For each sectional system there is available a set of associated values of d, x_c, x_d, and x_i, and provided the number of sections suffices, the three coefficients can be computed (using a modified method, to allow for the omission of a). Each coefficient, multiplied by the corresponding annual kWh sales, then gives an estimate of the contribution of the particular class of consumers to the aggregate demand on the sectional system at the half-hour in question. If we are mainly interested in groups of sections or the total system, we can multiply direct by the correspondingly summed kWh sales; and by making similar analyses for other half-hours, the complete load curves of the three consumer classes for the day in question can be evolved.

It may be found baffling that the kWh sales to a class of consumers, which are constant for a given sectional system, can thus be translated into variable demand figures, not only for any half-hour of a given day, but also for entirely different days. However, what varies is the calculated coefficient for each of the half-hours, whereas the kWh sales only measure the relative magnitude of the classes of consumers in the sectional systems concerned. Take, for instance, the half-hour 2.30-3 p.m. of a winter day, when the domestic demand is relatively low, whereas the commercial and industrial demands are relatively high. For predominantly residential sections, with relatively large x_d, the system demand, d, will be relatively low, and, therefore, the multiple-regression analysis will throw up a relatively small coefficient b_d. On the other hand, at, say, 6-6.30 p.m. of the same day, such sections will have a relatively high system demand, and a relatively large b_d will result.

Similar considerations apply to predominantly industrial sections, in which at 2.30-3 p.m. the system demand will be much higher than at 6-6.30 p.m., leading to a value of b_i much larger for the former than for the latter half-hour. The beauty of multiple regression is that it enables these partial relationships to be separated out, provided data for a sufficient number of differing sets of conditions are available.

The existence and degree of a combined linear relationship can be tested by calculating the multiple-correlation coefficient, the mathematics of which is, however, beyond the purview of this article.

Practical Application

The method in question has been applied to estimating the contributions of the principal classes of consumers to the demand on the grid, based on daily load curves of a large number of sub-areas and the corresponding annual kWh sales to the consumer classes concerned. Both winter and summer days have been analysed, beginning with the year 1951-52, but while the results appear to be definitely promising, corroboration by analyses for further years is awaited before details are published.

The regression coefficients obtained have also been used to make similar estimates for individual Area Boards, bearing in mind that these coefficients are in the nature of "weighted averages" and that the results require adjustment if the particular conditions deviate a great deal from the average. This applies particularly to the industrial load in areas with a large proportion of heavy industry. However, the results obtained are encouraging.

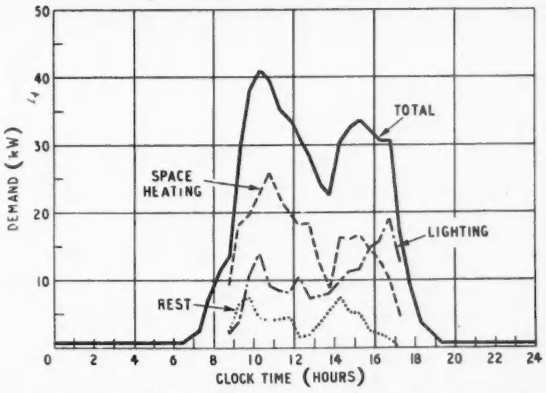
Modifications being studied consist of the use of quarterly kWh sales and the splitting-up of class loads. For instance, as the load characteristics of small and large industrial consumers differ, improvements are expected from subdividing the annual kWh sales accordingly, whereas the results of the recent sampling survey of domestic consumers will enable the domestic sales to be subdivided into "cooking," "space heating," etc.

Installed-Load Basis

After the above method of system load analysis had been developed here, a Swiss author[3] suggested multiple-regression analysis based on the installed load of the consumers in a number of supply systems. In the article referred to, the installed motor, cooking, and heating loads of the consumers in nine substation areas are used, and as nine sets of data are not sufficient, five days are taken, giving a total of 45 sets for each time of day selected. The analysis, therefore, does not yield the load characteristics for a particular day, but the average for five. In order to analyse a single day, e.g. a particularly cold one, it would be necessary to make appliance surveys at the consumers of a much larger number of substation areas.

This method has now been both simplified and further developed in this country by selecting samples of consumers and installing a recording instrument for each consumer. Depending on the homogeneity of the type of consumer concerned, the samples can be relatively small. For instance, a test on a sample of only 25 office consumers with annual consumptions below 5,000 kWh gave satisfactory results. The sample was selected from the consumers of a large northern town, load recordings being obtained for the second half of January, 1954. By summing the individual daily load curves, collective load curves for the type of consumer in question were produced in the usual manner, while multiple-regression analysis, based on the individual consumers' half-hour demands and the records of their installed load, yielded component load curves for "lighting," "space heating" and "rest." The graph shows the result for a cold Tuesday.

It will be seen that the half-hour by half-hour analysis yielded consistent load curves, space heating reaching its



Analysis of the collective load curve for a winter day of a sample of 25 office consumers with annual consumption of under 5,000 kWh

maximum at 10.30-11 a.m., and lighting at 4.30-5 p.m. The "rest" component contains cooking, water heating, motors, etc. As only a few of the 25 consumers had any of these, no further analysis was possible. However, if such an analysis were required, the best way would be to select samples of consumers possessing the particular type of appliance.

If whole classes or sub-classes of commercial or industrial consumers are to be analysed, with the size of individual consumers varying over a wide range, larger samples are needed, but their size can be kept within reasonable limits by "stratifying" them according to size of consumer, and increasing the proportion of consumers for the larger sizes.

Demand Factors

When using installed load as reference, each of the ensuing coefficients represents the average contribution per installed kilowatt of the component concerned to the demand at a particular half-hour of the day analysed. The table illustrates this for the time of the collective peak of the type of office load investigated, and for the half-hour 4.30-5 p.m., when peak demands are possible in some systems, especially in the early winter. These coefficients may be described as "effective demand factors," in modification of the accepted definition of demand factor as the ratio of maximum demand to installed load.

EFFECTIVE DEMAND FACTORS
(Offices up to 5,000 kWh year)

Component Load	Demand, in kW per kW installed, at	
	10-10.30 a.m.	4.30-5 p.m.
Lighting	0·55	0·8
Space heating	0·45	0·2
Rest	0·3	0·1

The table shows that at 10-10.30 a.m. on the day in question, some 55, 45 and 30 per cent of the installed lighting, space heating and "rest" loads, respectively, were in use, while for 4.30-5 p.m., the proportions were 80, 20 and 10 per cent. Moreover, it can be used to illustrate the practical utility of this kind of investigation in the design of such two-part or variable-block tariffs as are not based on metered maximum demand but on "assessed demand," with differentiation of the assessment rates according to type of load, e.g. lighting, space heating, power, etc.

The initial problem is to determine the fixed charges, or sizes of block, per kW installed in such a way that the total revenue under the tariff approximately equals what it would be if it were based on metered m.d. In this form, the problem can be attacked by selecting a sample of consumers, installing a m.d. indicator with each of them, and, after ascertaining the installed loads concerned, finding, by multiple regression and for each of the relevant component loads, the effective demand factor relative to the individual consumer's m.d.

When using this m.d., no account can be taken of dissimilarities in the diversity of the individual component loads relative to the system peaks. But if the complete daily load curve of each component load and the corresponding effective demand factors are available, a supply undertaking with a predominantly morning peak will use the factors for the morning, whereas an undertaking with a predominantly late-afternoon peak will adopt quite different ones. In cases where there is no longer an absolutely predominating peak, refinements—such as the introduction of "potential peak periods"—must be introduced, but these can also be applied to the choice of effective demand factors.

For types or sub-classes of consumers which are not too heterogeneous, the allocation of demand-related costs to individual consumers may thus actually be more accurate with an assessed-demand tariff designed on the above basis than with a tariff based on the metered m.d. occurring at any time during an accounting period.

This is just one example of the practical utility of load-curve analysis by multiple regression. The ideal aim is, of course, to produce similar information for all major types of consumer, but although the laborious calculations involved can be expedited by the use of automatic computers, this will take some time to accomplish.

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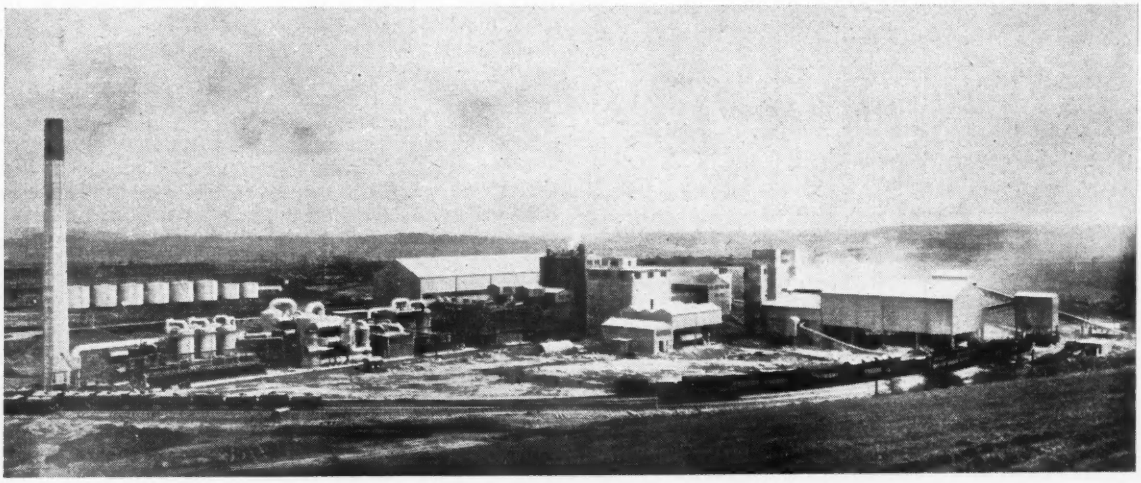
Tri-Dimensional Analogue Computer

PRINCIPLES and methods of operating the large analogue computing machine, known as "Tridac," at the Royal Aircraft Establishment were described to the Institution of Electrical Engineers (Measurements Section) on 1st December. The authors were Lt.-Comdr. F. R. J. Spearman (Ministry of Supply, formerly at R.A.E.) and Messrs. J. J. Gait (R.A.E.), A. V. Hemingway (Tube Investments, formerly with Elliott Bros.) and R. W. Hynes (Long Range Weapons Establishment, Australia, formerly with Elliott Bros.).

The purpose of Tridac, which cost £750,000 to develop and manufacture though production costs of a similar machine would probably amount to about £250,000, was stated to be the calculation (by means of models) in three dimensions of the trajectory of one aircraft pursuing another or of a guided missile attacking a target. Other applications suggested were aircraft flight, human control of machines, economics and military tactics. The saving in cost of firing guided missiles on tests was held to be high enough to justify the high manufacturing cost of the machine. As it had electronic, mechanical and hydraulic components and operated on a 1:1 time scale, real components could be included in the computation. Some 2,000 electronic units were incorporated, and either drift-corrected d.c. amplifiers or electrically controlled servo-motors were employed in performing the mathematical work.



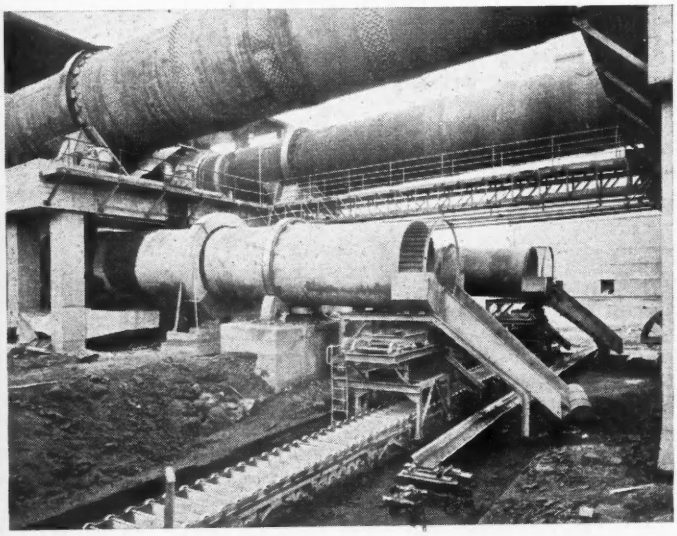
LARGE CHEMICAL PLANT

Combined Acid and Cement Production Unit

THE opening of the large new sulphuric acid and cement producing plant of Solway Chemicals, Ltd., at Whitehaven, Cumberland, marks the virtual completion of a period of conversion and construction, which began in 1951, on a number of sulphuric acid plants throughout the country. This was brought about by restrictions being imposed on the export of supplies of elemental crude sulphur from the United States. These restrictions, together with a British shortage of dollars, were primarily responsible for the Solway and other projects being initiated, and now, as a result, this country will be rendered increasingly independent for its supplies of this valuable commodity.

The new plant, which was inspected by the Duke of Edinburgh on 24th November, involves the production of sulphuric acid and the co-product cement by means of processes which are integrated to provide a single continuous process in which the benefits of electricity and automatic control have been fully exploited.

The main rotary kilns above with the clinker coolers below



Essentially, the plant can be regarded as being composed of six main sections: the raw material mines, the crushing plant, the mixing plant, the two processing sections (one for cement and the other for acid) and finally the facilities provided for the storage and shipment of the finished products.

The basic material in the process is anhydrite and this is mined on site. Having been brought to the surface it undergoes two stages of crushing and is then mixed in accurately weighed proportions with shale and coke, the former also being mined on site and the latter obtained locally. After being carefully dried the mixture is conveyed to the grinding mill house, where it is reduced to a very fine powder and "pumped" dry into storage silos. The mixture is then roasted in a coal-fired rotary kiln, at temperatures in the region of 1,400 deg C. This results in the production of gases containing sulphur dioxide and anhydrite clinker. After roasting, the sulphur dioxide is drawn through the kiln and the remainder of the acid plant by means of turbo-blowers during which process purification of the gas, conversion to sulphur trioxide and absorption of this in water to form sulphuric acid, take place. Meanwhile, the production of cement goes on as a separate process. After the cement clinker is taken from the kiln it is conveyed to the clinker building and there it is mixed with gypsum and ground to form cement. From the clinker building it is then "pumped" dry to the cement packing building where it is automatically bagged for distribution by the Cement Marketing Board.

Ring Main Distribution

In 1952, when general plans for the project had been agreed, Crompton Parkinson, Ltd., were commissioned to be responsible for the whole of the electrical services. In this task the company has worked in close collaboration with the engineering department of Marchon Products, Ltd., the parent concern of Solway Chemicals, Ltd., which acted as main contractor.

Early in the planning stages it was decided to install an

11 kV ring main system. Five main substations were erected as part of the ring main system and were placed at the main concentrations of load. As the mine and crushing plant had to be in the extreme south-west corner of the site it was found necessary to exclude them from the ring main, and to erect another substation separately fed from the main incoming substation through two 11 kV duplicate feeders, using 0·2 sq in cable. This substation controls supplies to the preparation and handling plant for the raw materials, as well as to the mine and crushing plant.

The ring main cable laid down is of 0·3 sq in size, to provide adequate capacity for future extensions. It has already proved its worth in that the present output of the plant is 100,000 tons of cement and 100,000 tons of acid per year, 30,000 tons of each product more than the original estimated output. This additional output, of course, has introduced a larger electrical load than was originally contemplated, but the only modification to the distribution system that has been necessary has been the provision of a 3·3 kV supply for the 850 h.p. grinding mill motors. This h.v. supply for the grinding plant is in contrast to the 440 V supplies standardized for practically all other equipment.

Originally, proposals were considered for the ring main to be erected overhead to avoid acid attack. Such a system, however, was found to be impracticable due to its vulnerability during construction work, and it was subsequently decided to install the ring main underground. Where it had to be routed through the acid section and under roads and railways, it was piped. Further precautions were taken in the acid section to guard against damage due to possible acid seepage, and an overall protective sheathing for the cable was provided as standard for the complete installation.

Precautions Against Acid Fumes

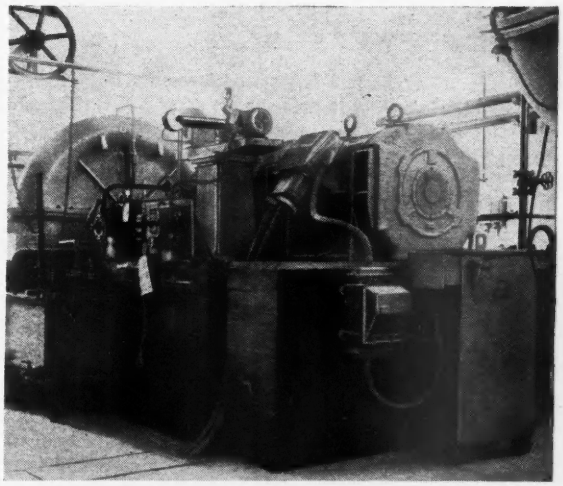
Particular attention had to be given to the effects of acid fumes in the atmosphere and for this reason all outdoor transformers were hermetically sealed as distinct from the usual practice of providing them with conservators. They were also finished with an anti-sulphuric acid paint. Only two standard sizes of power transformers were used, 750 kVA for the 3·3 kV supplies and 1,000 kVA for the 440 V supplies.

The switchgear, all of which is housed in standard brick and concrete buildings, has also been standardized. All h.v. switchgear consists of Crompton Parkinson type ALA vertical isolation oil circuit-breakers with air-insulated busbars, suitable for fault levels of 150 MVA, while the 3·3 kV and l.v. switchgear is of " Klad " design, except for a number of the ring main controls for which type ASA isolators have been employed.

Electro-tinning of copper busbars and connections was made standard procedure, but where the bare copper could not be tinned it was coated with an anti-acid varnish. Similarly, adequate precautions were taken with the cable installation. All paper insulated cables for h.v. and l.v. distribution are of Crompton manufacture and incorporate an anti-corrosive covering to protect the armour and lead sheathing from possible acid seepage. Special precautions were also taken at the jointing positions.

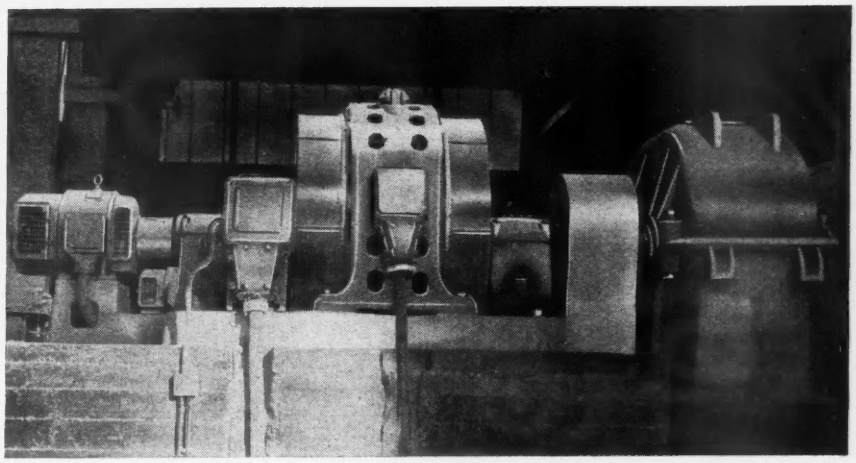
As it was intended from the outset that the ring main should operate " open," non-directional inverse time relays were preferred to pilot protection. These Reyrolle T.J.X. relays were time graded in collaboration with the North Western Electricity Board, which have similar relays in the main incoming substation.

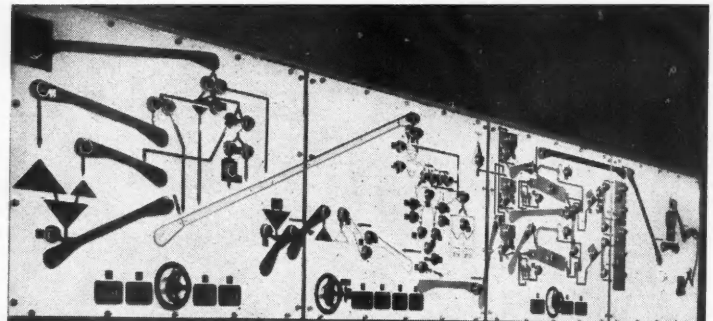
So far a total of 437 motors ranging from 850 h.p. down to fractional h.p. have been installed. It was originally planned that the three 850 h.p. grinding mill motors should be of the auto-synchronous type with a leading power factor to correct the power factor of the complete system to at least 0·9 lag. Now, owing to an attractive tariff from the North Western Electricity Board for off-peak grinding, some 550 kVA of static power factor improvement equipment has been installed to obtain the obligatory power factor of 0·9 during daytime operation when the grinding mills are shut down. Another step taken to ensure that the plant is operated economically is the provision of metering equipment on each transformer and also on the mine system for cost calculation purposes.



This 400 h.p. double-cage induction motor produces 40 per cent of full load torque with 3½ times full load current during starting

One of the two 850 h.p. 750 r.p.m. auto-synchronous grinding mill motors





This mimic diagram panel facilitates complete process control of all the raw materials and can provide for over 120 different sequences

An important part in the acid processing is played by three 400 h.p. Crompton Parkinson type "N" induction motors. These machines produce 40 per cent of full-load torque with 3½ times full-load current during starting, by using double cage rotors. They are started direct-on-line by means of 1,000 A solenoid operated "Klad" switchgear in "V" substation, remotely controlled by push-button at the motors.

The Fuller-Kinyon air compressors used for pumping the anhydrite and cement demanded slip-ring motors designed to produce 250 per cent full-load torque to enable the plant to be started up with the pipes full. In line with the method of standardization adopted throughout the plant, starters were, wherever possible, of the Ellison oil-immersed hand-operated type. Liquid and automatic starters were supplied by Allen West & Co.

Because much of the processing plant operates in the open, a large portion of the artificial lighting is carried out by Crompton 250 W mercury vapour lamps fitted in "Leo" type lanterns. These are either mounted on conventional street lighting concrete columns or on the steel supporting structures of the plant. The remainder of the plant lighting employs tungsten lamps.

The electrical installation has required very little alteration since it was first planned in 1952, despite the fact that the increases in plant output have entailed a considerable amount of extra electrical load. Records indicate that the maximum demand will remain in the region of 3,750 kW, with a consumption of 20 million kWh per annum. The average power factor of the installation has been calculated to be 0·93 lagging with a load factor of 59·6 per cent and a distribution efficiency of 89·5 per cent.

Recruitment of Scientists and Engineers

THE Advisory Council on Scientific Policy, which is responsible for advising the Lord President of the Council in the exercise of his responsibilities in the field of Government scientific policy, referred in its annual report (Cmd. 9537) to an inquiry it was making into some problems affecting the recruitment of graduates and apprentices by the engineering industry. A report on this subject, "Report on the Recruitment of Scientists and Engineers by the Engineering Industry," prepared by the Council's Committee on Scientific Manpower under the chairmanship of Professor S. Zuckerman, has now been issued by the Office of the Lord President of the Council and describes the results of an inquiry among leading firms in the engineering industry and four of the nationalized industries. The report is available at the Stationery Office; price 1s 3d net.

The inquiry was prompted by reports that some firms viewed with misgiving the expansion of higher technological education and research at the universities. One of the main fears was that such men as go to the universities to take up engineering were likely to be lost to industry for too long, and to study and to do research on topics of little value to industry. Another was that the increase in the size of the university population was "creaming off" talent which would otherwise have entered industry directly as apprentices.

The inquiry was confined to a number of large organisations in the engineering manufacturing industry, but it is estimated that the firms consulted recruited over half of the number of young engineering graduates finding jobs in industry in the last few years. The results of the inquiry show that there is a substantial unsatisfied demand for engineering graduates, especially for graduates with good honours degrees and capacity for leadership, though the extent of the demand varies considerably between different branches of the industry. The Committee points out that this gap between supply and demand, at present estimated at about one quarter, is bound to grow unless the output of the universities can be considerably increased. Some firms are worried about the effect of an expansion of the universities on the numbers and quality of boys available for training as apprentices, but the Committee on Scientific Manpower does not consider that this represents a real danger. It points out that there is an ample reservoir of untapped talent in the country and that the real objective should be to persuade more boys of outstanding ability to choose engineering as a career.

The inquiry shows that some firms are doubtful about the value to industry of post-graduate research in engineering at the universities. The Committee on Scientific Manpower does not, however, consider that these doubts call for any change in university plans to expand post-graduate work in engineering, as the scale of post-graduate research work planned is in general no greater than is necessary to ensure that university engineering departments will thrive as scientific institutions. The Committee emphasizes further that there is an urgent need for more post-graduate instructional courses, as opposed to engineering research at the universities.

The report contains a brief description of the apprenticeship schemes at present in existence in the engineering industry, and summarizes the varying views expressed by firms about the value of training the "hard way" as compared with that given by universities. Many firms are coming to regard some kind of "sandwich" scheme as the best solution. The normal type of such schemes is for boys to spend six months of the year in a technical college and the rest of the time at the works. But many firms now favour a "1:3:1" system in which boys spend one year in industry, three years at a university and then a final year in industry.

Two appendices to the report give extracts from letters received from firms and from four nationalized industries.

INDUSTRIAL NEWS

Investigation of Nationalized Industries

In July last a Select Committee was appointed by the House of Commons to examine the reports and accounts of nationalized industries and obtain further information as to so much of their current policies and practice as were not matters which were the responsibility of Ministers, did not concern wages and conditions of employment, were not dealt with by formal machinery established by the relevant statutes, or were matters of day-to-day administration. The Committee succeeded an earlier, similar, Committee which was dissolved upon the prorogation of Parliament.

The present Committee, of which Sir Patrick Spens is chairman and Mr. A. M. F. Palmer one of the members, has produced a special report (No. 120, H.M. Stationery Office, 2s 6d). In this it says that at its first meeting doubts were expressed about the permissible scope of its work and inquiries. It was decided to ask the Ministers concerned to supply lists of matters in the nationalized industries for which they considered themselves to be clearly responsible and on what matters of current policy and practice in those industries they had taken decisions. The Committee also called for memoranda from liaison officers appointed by the Ministers setting out the Ministers' statutory powers.

The Ministers' replies and the liaison officers' memoranda are set out in the minutes of evidence and appendices to the report. Having regard to the immense number and scope of the matters detailed in these statements the Committee feels that the only matters on which it could usefully obtain information fall within the limitations imposed by its order of reference. In the Committee's opinion the order as drafted leaves insufficient scope to make inquiries or to obtain further information and it so informs the House.

Research Results at B.I.F.

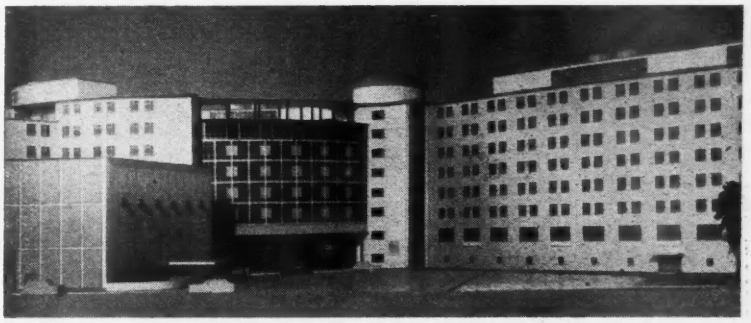
The British Industries Fair, in co-operation with the Department of Scientific and Industrial Research, is arranging a display of new products and new processes developed by the application of the results of research irrespective of where the research was done. This display will be shown on a special stand in a prominent position at Castle Bromwich from 23rd April to 4th May, 1956. In addition, it is proposed to show the same display at the Production Exhibition at Olympia from 23rd to 31st May.

Products and processes for the stand will be selected from suggestions made by industry and research organizations. Further products and processes selected as suitable, even if not shown owing to lack of space, will be considered by the D.S.I.R. when advice is requested by other Government Departments on material for official stands at overseas trade fairs.

Firms and research organizations are asked to submit particulars of new products and processes. Those whose products are selected will be invited to show these products on the stand, the cost of design and construction of which, at both the B.I.F. and the Production Exhibition, will be borne by the D.S.I.R. Firms will be expected to bear the cost of carriage and erection of their products in accordance with the designer's instructions; they will also be expected to staff their exhibit. Suggestions should be sent to the Chief Information Officer, D.S.I.R., 5-11, Regent Street, London, S.W.1, by 20th December.

B.B.C. Television Centre

The B.B.C. has placed a contract with George Wimpey & Co., Ltd., for the excavation and foundations of the main building to be erected at the Television Centre, Wood Lane, London. This will be the third stage in the B.B.C.'s building programme for the development of the site. It will be preliminary to the building, later, of the superstructure which will be in the form of a multi-storey "ring" building of nine floors, enclosing a court some 150ft in diameter. In the "ring" there will be dressing rooms, wardrobe space and engineering areas on the lower floors, with offices above. Radiating from it will be television production studios, telecine and telerecording areas, and a central control room. The outer periphery of the studios will be enclosed by a continuous runway along which scenery and properties can be conveyed to the studios from the scenery block, which is completed and in use. What is to be the restaurant block for the whole project is also in use, though at present for rehearsal rooms and offices. The area to be enclosed by the "ring" building and buildings radiating from it will be 3½ acres. The foundations and retaining wall of this section of the main project are to be completed by the end of September next year, when the building of the superstructure will commence, to be ready for occupation in 1960. The architect for the works is Mr. Graham Dawbarn (Norman & Dawbarn), in association with M. T. Tudsbery (consulting civil engineer to the B.B.C.), with Sir Howard Robertson and Sir William Holford as architectural consultants. The quantity surveyors are Messrs. Ainsley.



General view of a model of the main block of the B.B.C. Television Centre to be erected at Wood Lane, London

Engineering Pay Claims

A claim for equality of pay for men and women clerical workers in the engineering industry made by the Clerical and Administrative Union was rejected by the Engineering and Allied Employers' National Federation last week. The Federation promised to consider a demand for a general increase ranging from 11s 9d to 25s a week for all clerks, male and female, employed in the engineering industry.

Applications for higher salaries by the Association of Engineering and Shipbuilding Draughtsmen and the Association of Scientific Workers were also presented to the Federation at the same meeting.

Ministry of Labour Appointments Services

The October issue of the *Ministry of Labour Gazette* gives particulars of the work of the Appointments Services of the Ministry of Labour and National Service. This includes a technical and scientific register and an appointments register. The former provides a placing and advisory service for the various professions, the qualifications for enrolment being a university degree or membership of the appropriate professional institution. A register of vacancies is maintained, which in-

cludes a wide range of overseas vacancies. The vacancies outstanding at 16th August last totalled 5,626, a further 528 were notified in the period 16th August to 12th September, 155 vacancies were filled in that period, and 442 were cancelled or withdrawn, leaving 5,557 unfilled at 12th September.

The appointments register, which is concerned with the placing of other professional workers and persons with administrative, managerial or senior executive experience or qualifications, shows that at 12th September there were 74 vacancies for electrical engineering executives. Of the registrants in this section, 105 were employed and 45 unemployed.

A.S.E.E. Diploma Scheme

The Executive Council of the Association of Supervising Electrical Engineers announces that its diploma scheme examinations will be held on 23rd and 24th May next. This will be the tenth examination held under the scheme, which was inaugurated in 1946. It provides for examinations to be held each year leading to the award of the A.S.E.E. Diploma, the A.S.E.E. Technician's Certificate and premiums to the most successful candidates. The subjects covered by the scheme are electrical installation practice and work and electrical maintenance. Folders setting out the details of the scheme are available from the general secretary of the Association, 23, Bloomsbury Square, London, W.C.1.

Commercial Travellers' Schools

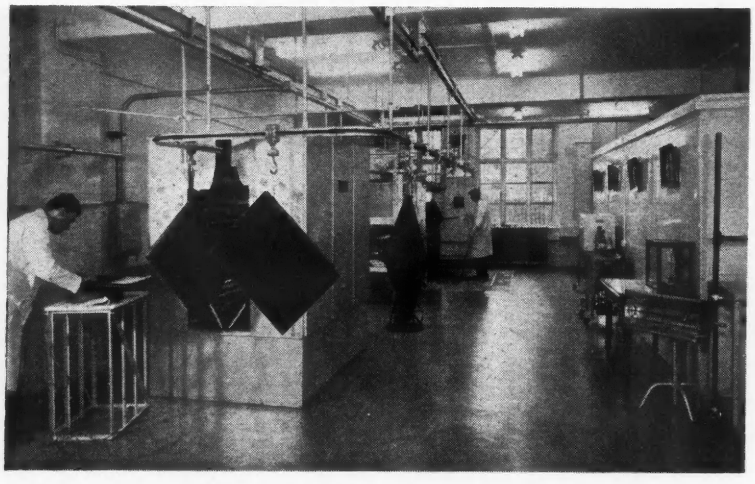
The annual festival dinner of the Royal Commercial Travellers' Schools will be held on 9th March next at the Trocadero Restaurant, London, W.1.

Metrovick Infra-Red Demonstration Section

The Metropolitan-Vickers Electrical Co., Ltd., has recently completed the reorganization of its infra-red demonstration section on the first floor at 132-135, Long Acre, London, W.C.2. The company was a pioneer in the development of industrial infra-red lamp plants for paint stoving on aeroplanes in the last war and this demonstration room still includes a lamp plant, although emphasis is now on the tubular sheathed element type of plant which, in addition to being more robust, also permits higher loadings per square inch. All the plants are operative and have a total connected load of approximately 90 kW. The equipment includes a variable speed mono-rail conveyor, a 6ft spray booth, test panels and associated instruments. Many organizations already have availed themselves of the demonstration section to test the suitability of infra-red heating in connection with their products. Heating engineers are in attendance and are dealing daily with industrial applications where heat processing is required for paint stoving, moisture extraction, preheating and curing.

Ironing Made Easy

As a further step to publicizing its home laundry equipment, Parnall (Yate), Ltd., has produced three films demonstrating its "Ezy-Press" electric ironer, which were given a private showing in London last week. Each film uses a typical demonstration by one of the company's demonstrators as a basis, with variations in the commentary for special types of audiences. "A Demonstration of the Parnall Ezy-Press" is intended to teach demonstrators how to sell the ironer; it is in 16 mm Kodachrome colour and runs for 15 minutes. The company states that it has already been accepted by Electricity Boards for training purposes. "Take It Easy" is designed for showing to the buying public in Electricity Board showrooms, Women's Institutes, etc. This is also in 16 mm Kodachrome colour with a running time of 15 minutes. The third film is a 2-minute "short" (35 mm Eastman colour) suitable for cinema audiences. In each film emphasis is laid upon the ease and speed with which household laundry can be ironed, and the absence of fatigue.



New Metrovick infra-red demonstration section

Census of Production

The "Report on the Census of Production for 1951, Volume 4, Trade O" has recently been published by H. M. Stationery Office for the Board of Trade (price 1s 6d). This covers the electric lighting accessories and fittings trade and shows that the larger establishments (those employing ten or more persons) had a gross output (production) of £17·7 million, as compared with £15·9 million for 1950. This increase was achieved in spite of a fall in the average number of persons employed from 16,436 to 14,978. The net output per person employed was £583 (against £508). With an aggregate of 245 persons employed by smaller firms (employing ten or fewer persons), the total estimated average employment was 15,229, as compared with 16,785 for 1950.

	Value £000	Entries No.
Electric lighting fittings and accessories:		
Auxiliary gear for discharge lighting	2,023	31
Domestic, decorative and commercial	3,610	111
Industrial, including flood-lighting and shop window lighting	5,241	86
Street lighting	904	24
Wiring accessories, up to 250 V 30 A (e.g., lampholders, ceiling roses, wall plugs and sockets, switches):		
Mainly of brass	1,402	34
Mainly of plastic material	5,643	74
Other (porcelain, etc.)	2,227	41
Unclassified	1,470	6
Electric bell apparatus, not telegraphic or telephonic	395	17
Waste products, other than scrap metals	1	7
Repair and maintenance work for customers	99	12
Total	23,015	127

Sales of the principal products, including sales of these products by establishments classified to other trades amounting to £9·4 million, are shown in the accompanying table.

A table giving the quantities of materials used by the larger establishments shows that the amount of brass and other copper alloys used, including nickel silver but excluding other nickel alloys, was over 63,000 cwt, and of non-alloy and alloy-steel, 9,500 tons.

New Piccadilly Sign

At the Criterion Restaurant, overlooking Piccadilly Circus, on 21st November a new illuminated sign was officially switched on by Mr. E. W. Rowbotham, chairman of the Ever Ready Co. (Great Britain), Ltd., assisted by Mr. J. F. Mallabar, chairman of Franco Signs, Ltd. It is claimed that the sign is the first illuminated display incorporating actual mechanical movement to be erected in Piccadilly Circus since the last war. It measures 44ft by 17ft 6in and consists of over 2,500ft of neon

The new "Ever Ready" sign in Piccadilly Circus

and fluorescent tubing and 116 transformers and ancillary gear. The central motif is a giant hand holding a mammoth torch. This moving unit, measuring nearly 23ft from the top of the beam to the wrist, weighs approximately half a ton. Powered by a geared electric motor, the hand holding the torch pivots from the wrist, directing a beam of light through an arc at the top of the sign. As the beam falls on each of the topmost Ever Ready batteries and emblem they light up and then flash off as the beam returns to the left. The sequence is repeated continuously. While this is taking place the other Ever Ready batteries flash on and off. The words "Ever Ready" are in 3ft 4in by 1ft 9in characters and are illuminated in red by four lines of neon tubing. Similar illumination is provided for the word "Batteries," which consists of 2ft letters. The slogan "For Life" is in 3ft and 2ft characters and illuminated by six lines of primrose yellow tubing. The border, in six lines of apple green fluorescent tubing, is housed in a trough to concentrate the light within a clearly defined area. The sign has been designed, manufactured and installed by Franco Signs, Ltd., in collaboration with the Ever Ready Co. and the advertising agents, Greenlys, Ltd.

G.E.C. Atomic Energy Arrangement

The G.E.C.-Simon-Carves Industrial Atomic Energy Group has come to an arrangement with the Motherwell Bridge & Engineering Co., Ltd., under which the latter company will be associated with them in the construction of nuclear power stations. The Motherwell Bridge & Engineering Co. is closely associated with the Chicago Bridge & Iron Co., of America, and a free interchange of technical developments and research takes place between the two companies. They are the sole licensees for "Hortonspheres" and are at present constructing the 140ft diameter sphere for the United Kingdom Atomic Energy Authority's experimental fast reactor at Dounreay, Caithness.

Electricity in Tropical Countries

Problems raised by electrification in tropical countries will be the subject of a two-day study conference to be held in Paris on 28th and 29th May next. Organized by an international UNIPEDE Committee it will deal with plant operation, distribution systems and transmission lines. The influence of climatic conditions on the design and construction of equipment will be examined generally, with special attention to insulating materials, protection of metal parts and packaging of equipment for transport and storage. Up-to-date documentary films will be shown to illustrate the efforts now being made to introduce electricity to tropical countries.

It will be noted that the conference is to be held immediately before the 1956 CIGRE meeting so as to afford delegates to this meeting the best opportunity of attending. Application to participate in the conference should be directed to the Secretary's Office at Electricité de France, 77, Avenue Raymond Poincaré, Paris, preferably through Mr. V. A. H. Clements, assistant commercial manager, Central Electricity Authority, the British representative on the Committee, at Bankside House, Sumner Street, London, S.E.1.

Tinplate Workers' Travelling Scholarships

The Court of the Worshipful Company of Tinplate Workers has again decided to offer twelve travelling scholarships for 1956, each to the value of £50, on the same terms and conditions as last year.

Engineering Design Consultants

The formation of a new technical and professional association is announced. This is the Federation of Engineering Design Consultants, whose headquarters, for the time being, will be St. Stephen's House, Westminster, London, S.W.1. As the name implies, the Federation draws its members from the ranks of firms of design consultants and contract drawing offices serving the engineering industry. The chairman, Mr. Ray Body, of E. G. Irwin & Partners, Ltd., has issued a statement in which he says that the first aim of the Federation is to represent the interests of its industry, but these interests are closely associated with the interests of their clients and the skilled employees who serve the profession. They want to establish and maintain a high standard of service.

Research in Technical Colleges

A survey conducted by the West Midlands Advisory Council for Further Education has shown the considerable volume of research work which is being undertaken in senior technical colleges in the West Midlands. About six colleges have active programmes which include research projects sponsored by Government departments or individual firms. Several colleges have appointed research assistants or fellows. Some 60 original papers have been contributed to scientific journals during the last four years from college staffs.

Purchase Tax Corrections

Crosslands (Rugeley), Ltd., inform us that incorrect purchase tax amounts are inadvertently given in their advertisements in last week's issue and this week. The correct figures are as follows:—Convectors: 900/1, £2 14s 2d; 900/2, £3 6s 0d; 900/3, £3 13s 8d. Fires: 800/1, £1 0s 7d; 800/2, £1 7s 10d.

Antarctic Expeditions

Auto Diesels, Ltd., of Uxbridge, have supplied the entire generating equipment for the three Antarctic expeditions which have set sail recently.

Two 6 kW generating sets, fitted with Enfield engines and MacFarlane alternators, were provided for the Trans-Antarctic Expedition the advance party of which left in M.V. *Theron* on 14th November. These sets will provide power for electric lighting, heating and radio communications. They will be installed at the base which the advance party will establish on the shores of the Weddell Sea, near Vahsel Bay. The Expedition are also taking with them a small Auto Diesels portable generating set, model AL 500, which will actually be taken on the overland trip which is the real object of the Expedition, across the South Pole. Four 7½ kVA alternating sets fitted with Brush Electrical alternators were supplied also by Auto Diesels for use with the Royal Society's Expedition for the Geophysical Year, which sailed in the *Tottan* on 20th November, and Hunting Aero-Surveys are also taking Auto Diesels generating equipment on their research expedition which left in October.

Wholesalers' New Showrooms

Mr. R. D. McCraith, president of the E.C.A. of Scotland, formally opened the new showrooms of T. Stanley Weston & Co., Ltd., electrical wholesalers, at 194, Bath Street, Glasgow, on 21st November, before a gathering representative of the contracting and electrical trade. Congratulating the company on the establishment of such comprehensive showrooms, he said that the electrical

A view of the new showrooms opened in Glasgow by T. Stanley Weston & Co., Ltd.

contracting industry must approve of any development such as this. It was quite impossible for the contractor to run a showroom of this nature. Mr. T. Stanley Weston said they were convinced that the trade really needed some place to send their customers. It was unfair to expect the contractor or the retailer to carry large stocks; they had sought and provided a showroom where contractors, retailers and their customers could see a very complete range of appliances.

The new showrooms consist of a four-storey block with basement. The premises have been subdivided into a series of attractive showrooms, including on the ground floor contemporary lighting, antique lighting, inexpensive lighting and traditional lighting; in the main hall is a series of showrooms, including a clock and kitchenware section, external lighting section, bathroom fittings, a kitchen appliance and refrigeration section, and a small appliance section. There is a large trade counter section in the basement, with entry from the rear. The upper floors have been converted into storage and administrative space, making this one of the largest wholesale houses in Scotland. Decoration of the showrooms is in modern style and shows the equipment against suitable backgrounds.

British Instruments on Show in U.S.A.

At the invitation of the Board of Trade, fourteen British instrument firms will be displaying their latest range of nucleonic instruments at the Atomics Exposition, Cleveland, Ohio (10th-16th December). This follows the successful British show at the Atoms for Peace Exhibition, Geneva, and aims to open up fresh markets for this rapidly developing industry. The stand will be called Great Britain and it will be 550 sq ft in area. The Royal Coat of Arms and the SIMA insignia will be prominently displayed. Mr. W. R. Corfield, of the Atomic Energy Research Establishment, Harwell, Mr. A. W. Jones, managing director of Fleming Radio (Developments), Ltd., and Mr. W. J. Lloyd, sales manager of Sunvic Controls, Ltd., will be the experts attending the stand from this country, and there will also be several American agents present.

The following are the British instrument firms referred to:—Automatic Coil Winder & Electrical Equipment Co., Ltd.; Burndept, Ltd.; Cooke, Troughton & Simms, Ltd.; Edwards High Vacuum, Ltd.; Electronic Instruments, Ltd.; Ekco Electronics, Ltd.; E.M.I. Research Laboratories, Ltd.; Fleming Radio (Developments), Ltd.; Gamma-Rays, Ltd.; Labgear (Cambridge), Ltd.; Panax Equipment, Ltd.; Sunvic Controls, Ltd.; Townson & Mercer, Ltd.; and M. Falk & Co., Ltd.

New G.E.C. Depot

The General Electric Co., Ltd., will open a new depot at Magnet House, Derby Street, Preston, on 5th December. The new depot, under the management of Mr. R. G. Galloway, will be able to give better delivery services in the North Lancashire area than has hitherto been possible. The telephone number of the Preston depot will be Preston 57871/2.

Ideal Home Exhibition

The *Daily Mail* Ideal Home Exhibition, 1956, will be held at Olympia from 6th to 31st March.

On Load Tap Change Gear

Last week (page 1043) we published some notes on the on load tap change equipment of Maschinenfabrik Reinhausen which Transformers (Watford), Ltd., propose to supply with their transformers. We regret that the illustration of the gear was printed upside down.

Works Visits

A recent civic visitor to the main Liverpool factory of the Automatic Telephone & Electric Co., Ltd., was the Lord Mayor of Liverpool (Ald. R. R. Bailey). Accompanied by Mr. J. A. Mason (director and manager), Ald. Bailey toured the works and was shown some of the latest telecommunications developments.

For the first time in eight years, representatives of the electrical manufacturing industry were invited to attend one of the series of courses organized by the Manchester College of Technology, Department of Electrical Engineering, at Electricity Hall, Buxton. The subject covered by the course, which is under the auspices of the Manchester and District Advisory Council for Further Education and the Central Electricity Authority, was "Electrical Power System Insulation" and included a visit to the Prescot works of British Insulated Callender's Cables, Ltd. The party, which included many engineers from the headquarters, divisional and area staffs of the C.E.A., made a comprehensive tour of the works and saw the refining of copper and many of the processes in the manufacture of paper-insulated power cables.

Diary

From British Insulated Callender's Cables, Ltd., we have received a handsome desk diary, the covers of which bear illustrations in colour of Trafalgar Square and Windsor Castle. Each weekly page is faced by a picture relating to some aspect of the company's varied activities.

Trade Announcements

Electric and Musical Industries, Ltd., and **Collaro, Ltd.,** have both concluded licence agreements with the A.R.F. Development Corporation, a subsidiary of the Armour Research Foundation of the Illinois Institute of Technology, Chicago, which will enable them to use the many Armour patents in the field of magnetic recording.

Bill Switchgear, Ltd., is opening a branch office at 459, High Street, Cheltenham (telephone: Cheltenham 2812). The area manager will be Mr. C. Gearing, who has for many years been the company's representative in this area. The full facilities of the branch will be available from 5th December.

G. D. Harrison & Sons, Ltd., electrical wholesalers, Huddersfield, have taken additional premises in Brook Street, Huddersfield, which will serve as central warehouse, industrial and domestic showrooms, garages for vehicles, and offices. They expect to open there on 1st January next.

Enfield Cables, Ltd., announces that its Hull branch has been transferred to 23, Mytongate, Hull (telephone: Hull 35018), and that its Edinburgh branch is now at 75, Hanover Street, Edinburgh (telephone: Caledonian 3041).

The Peterborough office of **Mitchell Engineering, Ltd.,** is now at The Bridge, Peterborough, Northants.

The **Lewis Spring Co., Ltd.,** has moved its London offices and stores to 122, High Holborn, W.C.1. The new premises include a showroom displaying a comprehensive range of springs, wire work and pressings.

Tinsley Wire Industries, Ltd., has moved its offices to Fordhouse Road, Bushbury, Wolverhampton.

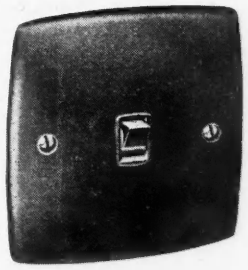
The address of **Harlec (Tipton), Ltd.,** is now Hacche Mill, South Molton, N. Devon.

Irish Cables, Ltd., has opened a London office at 19-21, Fitzroy Street, London, W.1 (telephone: Langham 8317).

NEW ELECTRICAL EQUIPMENT

Switches and Assemblies

The introduction of a new range of plate and switch assemblies, designed for use with both plaster depth and deep boxes, having 2⅜in centres, is



One of the new range of Simplex switches

announced by the SIMPLEX ELECTRIC CO., LTD., 217-219, Tottenham Court Road, London, W.1. Metal and wood boxes are available and each switch assembly can be supplied with four fixing screws. The switches are mounted to the plate from the back and the movement is totally enclosed. Ample cable room is allowed even when used with plaster depth boxes. The finish is in brown or ivory.

Domestic Refrigerators

Bold styling has been the theme in the production of the 1956 range of household refrigerators announced by the FRIGIDAIRE DIVISION of GENERAL MOTORS, Stag Lane, Kingsbury, N.W.9. New ideas in storage and convenience have been incorporated in the cabinets which are now available in radiant and pastel colour combinations, both inside and out.

The new de-luxe "DT-44" family sized refrigerator has 4·4 cu ft of storage space, more than 8 sq ft of shelf area, a large super-freezer, a butter compartment, door shelves, an interior light, a full-width hydrator, and acid resistant porcelain-on-steel table-top. Exterior dimensions are 24½in by 25¾in by 39in, including the table-top splash back. As with the larger models, the "DT-44" is equipped with a "Quickube" ice-cube tray producing 36 cocktail-size cubelets at a freezing. It has a gold anodized finish and a finger touch lever action to release cubes.

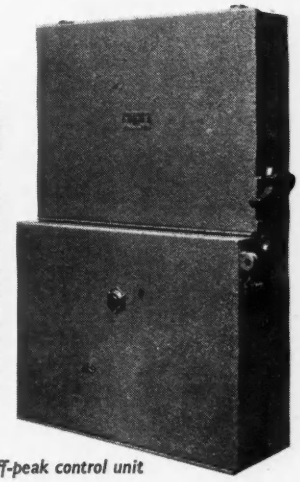
The remainder of the seven 1956 Frigidaire models range through five sizes from a standard 4·3 cu ft family model to two large de-luxe models, "ODT-79" and "ODT-98." The latter are fitted with butter and cheese compartments, four door shelves, hydrators, meat tenders, chill drawers, and full-width super-freezers capable of holding 51 lb and 45 lb of frozen food or ice cream respectively.

All the refrigerators have adjustable cold controls with twelve settings, and are operated by the "Meter-Miser" rotary compressor.

Off-Peak-Tariff Control Unit

ENGEL & GIBBS, LTD., of Warwick Road, Boreham Wood, Herts, have produced units designed for the automatic control of heating on premises taking advantage of special off-peak tariffs. They are manufactured in various sizes and combinations according to the application and load and are constructed in two-section boxes. The bottom section is used by the supply authority and contains the master time switch and main contactor. The customer's section above contains a main switch fuse-isolator, indicating lamp (to show when the contactor is closed), time clock (which can be set for any period within the master clock setting), and various outlet fuses and neutral links for outgoing connections. Standard unit ratings are available for 30, 60, 100 and 150 A, three-phase, four-wire supplies or single-phase, the output being split among the appropriate number of 15 A fuses.

Frigidaire de-luxe "DT-44" family sized refrigerator



Off-peak control unit

Portable Welding Transformer

A new transformer for use with portable spot welding equipments has recently been developed by the METROPOLITAN-VICKERS ELECTRICAL CO., LTD., Manchester. It has a 75 kVA rating based on a duty cycle of 50 per cent (1-"on," 1-"off") on a

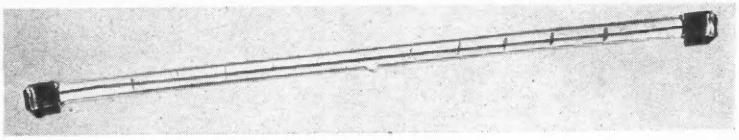
75 kVA welding transformer for overhead suspension

400 V supply. The secondary voltage can be varied from 18·2 V down to 4·5 V by means of primary links (seven positions) plus series parallel links on the secondary, so that 14 secondary voltages are obtainable. With this useful working range, even on the lowest tap, the transformer is rated at 65 kVA; thus the welding current may vary from 4,160 A on the highest voltage tap to 14,500 A on the lowest voltage tap.

The transformer is water-cooled and wound with Class B insulation, the conductors being glass covered and the intercoil insulation being glyptal bonded mica. It is designed for overhead suspension and if necessary the secondary headers shown in the illustration can be adapted to suit customers' particular requirements. The overall height (including hangers) is 3ft 4in and the weight (including hangers) is approximately 410 lb.

Quartz Infra-Red Lamp

In order to provide higher radiation intensities than are normally obtainable from an ordinary 250 W industrial infra-red lamp, PHILIPS ELECTRICAL, LTD., Century House, Shaftesbury Avenue, London, W.C.2, have



Philips 1,000 W quartz infra-red lamp

developed what is claimed to be the first 1,000 W quartz tubular infra-red lamp in Europe. The diameter of the tube is only 10 mm and the life of the lamp is approximately 5,000 hours when operated on the rated voltage.

If the closest arrangement—triangularly with a distance of 15 cm between the lamps, centre to centre—is used, the ordinary 250 W industrial infra-red lamp can be installed to provide 2·5 W/sq cm. This value can be trebled when the new quartz lamps are used. The glass normally used for incandescent lamps transmits infra-red rays up to a wavelength of about 5 microns but the transmission of quartz extends to wavelengths longer than 7 microns. The colour temperature of the filament is equal to that of normal infra-red lamps—about 2,200 deg K.

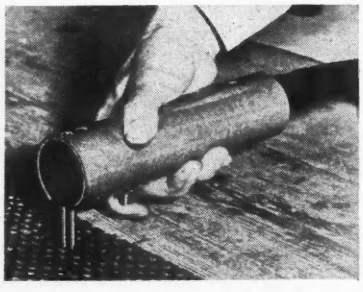
The new lamp is available from stock, and the list price is £4 4s.

Poke Welder

A poke welding device has been developed by the GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, W.C.2, for use with its 4 kVA electronically controlled spot welding machine. The device facilitates the spot welding of assemblies which are too large or too complicated to be accommodated in the machine, and allows reliable welding to be carried out when there is access to only one side of the metal. The poke welding attachment has flexible cables with terminals at one end for connection to the welding machine.

The performance of the poke welder has been proved in the aircraft industry where it is employed in the fabrication of sheet metal assemblies required for aero gas turbine engines. It is used to join stainless steel sheets 0·004in thick but has a wide range of potential applications.

The welding machine with which the attachment is used has been developed for spot welding very thin wires and sheets, particularly where dissimilar non-ferrous metals have to be joined. It supplies welding current in the form of heavy pulses of from one-half to six cycles duration (0·01-0·12 sec), the duration being accurately timed electronically whilst a synchronizing circuit ensures that welds always start at the same instant in a supply cycle so that the exact performance of the machine will be repeated. The fully variable controls have graduated scales to allow settings to be recorded.



G.E.C. poke welding device in use on crimped stainless steel

"Ferroxcube" Beads

The inductance and h.f. resistance of a straight wire can be increased appreciably by threading it through a small bead of "Ferroxcube," available now from MULLARD, LTD., Century House, Shaftesbury Avenue, W.C.2. This fact is made use of in a variety of h.f. decoupling applications, including simple "grid stoppers" to prevent parasitic oscillation, and decoupling circuits in heater leads.

The use of "Ferroxcube" beads for decoupling heater wiring is particularly attractive in that there is no increase in resistance at d.c. or supply frequencies, though the h.f. resistance may be increased by an appreciable amount by the addition of a single 3 mm bead. This large resistive component also reduces the risk of the decoupling elements themselves causing parasitic oscillation, since any tuned circuit formed by them will be heavily damped.

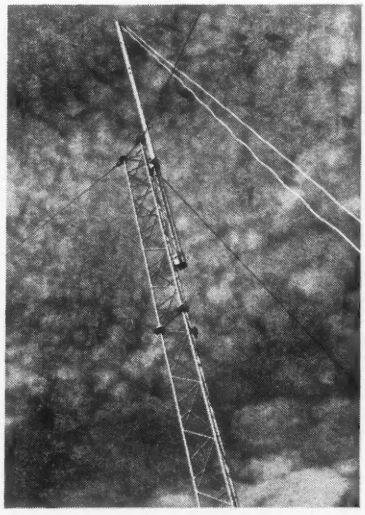
Two types of "Ferroxcube" bead are available from the component division of Mullard, Ltd.—Type FX1666 is suitable for applications involving relatively low radio frequencies, and Type FX1667 for high frequency circuits. Both take the form of short tubes (length 3 mm, inside diameter 1·2 mm and outside diameter 3·5 mm). The beads are put into circuit simply by slipping them over the relevant leads. They can be held in place if necessary by pieces of sleeving. More than one bead can be used to obtain increased inductance and loss resistance.

Unit Radio Mast

To meet the demand for a stayed mast which is cheap, light, transportable, climbable and easily erected, British Insulated Callender's Construction Co., Ltd., has developed a new design to be known as the "unit radio mast." This type of mast, which is being mass-produced by Painter Brothers, Ltd., of Hereford, consists of 10ft units and the mast can be built up in multiples of 10ft to a maximum height of 150ft. It is stayed at 20ft or 30ft intervals and stay plates are provided at each corner of the upper end of each unit. This light welded structure is of triangular section, each face of the triangle being 12in wide. Being constructed chiefly of steel tubes, the mast itself weighs only 7 lb/ft. Climbing rungs are incorporated in one face.

The units are constructed of mild steel and each consists of three tubular corner posts, braced together by rods. The assembly is welded together in a rotary jig. After fabrication the mast units are hot-dip galvanized and as the tubes are coated both inside and outside, efficient protection is given against corrosion. As erection progresses, additional units are added, using two ½in bolts at each corner joint. All bolts and other accessories are galvanized.

Erection can be accomplished with the minimum of labour, the mast being built up, section by section, in the vertical, using a light alloy derrick pole. These poles, together with the necessary fittings, are supplied as an extra item. A 150ft mast will withstand a head load of 1,000 lb plus a wind of 100 m.p.h.



Aluminium alloy derrick being used to lift mast section during erection

Electrical Machinery Trades

The Association of Electrical Machinery Trades announces that its 1956 Convention will be held from 14th to 17th April next at Southport. The annual dinner and dance will be on 16th November at the Savoy Hotel, London.

Electrical Accidents in Mines

Analysis of Mishaps in 1953

THE report of H.M. Principal Electrical Inspector of Mines for the year 1953 has been published this week. The total h.p. of electric motors in use for all purposes at mines under the Coal Mines Act, 1911, at 30th June, 1953, was 3,455,383, and the number of motors in use was 112,104. The comparable figures for 1952 were 3,326,539 h.p. and 105,157 motors, respectively, as shown below.

SURFACE			UNDERGROUND		
Duty	No. of Motors	Horse-power	Duty	No. of Motors	Horse-power
Air compressing ...	1,213	239,600	Staple winders ...	52	6,666
Winding	876	263,687	Air compressing ...	1,076	49,660
Ventilation ...	1,518	176,005	Haulage	11,347	562,718
Haulage	2,377	112,350	Conveyors ...	18,240	431,291
Coal cleaning ...	15,467	311,188	Coal loaders ...	463	16,169
Miscellaneous ...	23,349	341,439	Stone loaders ...	197	5,442
			Pumping	11,851	527,488
			Coal cutting ...	7,646	351,435
			Coal drilling ...	10,085	13,391
			Stone drilling ...	1,722	2,435
			Other portable machines ...	405	5,410
			Auxiliary ventilation	2,885	25,531
			Miscellaneous ...	1,335	13,478
Total	44,800	1,444,269	Total	67,304	2,011,114

There were two fatal electric shock accidents, one on the surface and the other underground. In the surface accident, the electrician came into contact with exposed live connections in an 11 kV switch which had been damaged earlier in the day following a lightning storm. The power had been restored after it was interrupted as the result of the storm. In the underground accident a conveyor motor and associated switchgear was being installed when the electrician sustained a fatal shock as he lifted the bare conductors of the ends of a live 550 V cable which should have been connected to a belt-slip protection switch.

In another fatal accident underground a bricklayer died from injuries sustained when he was trapped by moving tubs owing to a haulage being started by the inadvertent operation of the starting switch by shot firing in the immediate vicinity. There were 62 non-fatal electrical accidents (38 underground) resulting in injury to 64 persons. In addition, there were 20 dangerous occurrences, in two of which gas was ignited when a coalcutter trailing cable was damaged by moving coalcutter picks. Of the 64 persons involved, 38 were electricians, including seven apprentices, an increase of five over 1952.

Besides these accidents, a 15-year-old boy received a fatal shock from an overhead line to a colliery, and another fatal accident underground involved an electrician who was struck by a revolving slipring casing which had been incorrectly assembled.

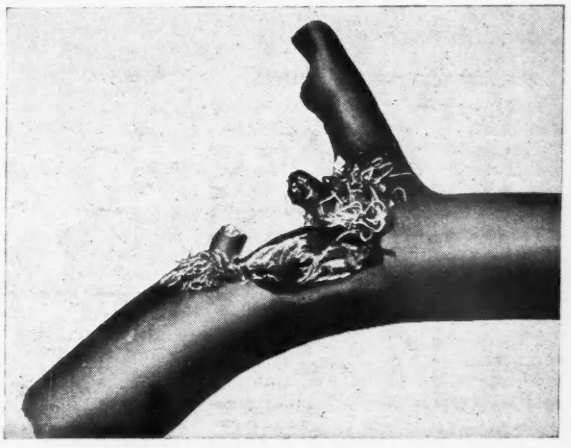
An analysis of the accidents shows that the two fatal accidents from "Electric shock and/or arc burns" for 1953 compare with five accidents similarly classified for 1952. In both 1952 and 1953 there was one accident under the classification of "Fire arising from electrical defects," making altogether three fatal accidents in 1953 compared with six in 1952. Contributory causes of two of the fatal accidents in 1953 are given as "Misuse, negligence or ignorance" (compared with four accidents under the same heading in 1952). The third fatal accident in 1953 is placed under the heading of "Organization and lack of equipment." Under the broader heading "Apparatus involved" two of the 1953 fatal accidents are classified under "Switchgear and fuses" (against four fatal accidents under the same classification for 1952) and the third fatal accident in 1953 is classified under "Armoured cable or accessories" (there was one accident under this classification in the previous year).

Non-fatal accidents in 1953 are classified as follows, with the 1952 figures in parentheses:—Electric shock and/or arc burns, 56 (56); ignition of fire damp or coal dust, 3 (5); fire arising from electrical difficulties, 16 (17); and other causes, 7 (11); making a total of 82 (89). Contributory causes are given as: Design or unsuitability of apparatus, 9 (9); installation or maintenance, 22 (32); misuse, negligence or ignorance 50 (40); and organization or lack of equipment, 1 (8). With regard to apparatus involved, the non-fatal accidents are analysed as follows: Switchgear and fuses, 51 (43); flexible cables and plugs, 17 (18); overhead lines, 2 (5); lighting accessories, 3 (8); coal cutting machines, 1 (1); armoured cable and accessories, 7 (8); and miscellaneous, 1 (5). In 1952 there was also one accident involving signalling bells.

The descriptions of selected non-fatal accidents given in the report include one in which firedamp was ignited in a cut by the resultant arcing when a coalcutter trailing cable below ground in a safety lamp mine was caught and damaged by the coalcutter moving picks. The power supply was 500 V, three-phase, 50 c/s and the neutral point of the system was earthed. Cutting had been in progress with the coalcutter travelling away from the mothergate where the gate-end switches were situated.

The trailing cable was lying across the top of the coalcutter and was secured at the goaf side jib-pin hole by a stick and a rope. After some 20 yards of face had been cut a fall of roof occurred which broke the stick and rope securing the cable and caused the cable to fall on to the cutter picks. The coalcutter stopped when a flash occurred at the damaged cable, gas was ignited and flames were seen to issue from under the cut. The flames in the cut were quickly extinguished by one of the coalcutter men applying stone dust, a bag of which was carried on the machine, and as a further precaution the cut was subsequently sprayed with water.

The trailing cable was of the individually screened type and the picks were found to have severed one of the power conductors and the pilot conductor. A small amount of fusion existed at the severed ends of the power conductor. Leakage protection was provided on the system but this did not operate at the time of the occurrence, probably because the pilot conductor of the damaged cable was severed at the same moment, so cutting off the power supply to the gate-end switch contactor.



Picks severed one of the power conductors and the pilot conductor of the screened trailing cable

Financial Section

STOCKS and SHARES

ANOTHER very quiet week's business in the Stock Exchange left little mark on the general level of prices. It may however be noted that although changes in the accompanying lists are consequently few, they are mostly for the better. New issues of shares have again monopolized much of the available interest: the premium on Tube Investments new ordinary shares rose to 38s after the date for the payment of the first instalment had passed. Other good features included Decca, Ericsson and Murex. K.G. Holdings 1s shares have been at times the most active stock in the industrial market, rising further to 6s 6d. They were 1s 3d earlier this year.

Locomotive Orders

Improvements in the shares of English Electric, A.E.I. and other of the big electrical groups concerned have been attributed at least in part to news of the British Transport Commission's first orders for main-line diesel locomotives and power units. The broad outline of the £1,200 million programme for the electrification and modernization of the railways has of course been known for about a year past and the £10 million value of the contracts now placed for 140 locomotives represents only a small fraction of the £125 million proposed to be spent in all on this particular equipment. Nevertheless, the actual placing of first orders served to recall attention to one of the strongest points in favour of many electrical engineering investments, and one which has perhaps been put lately in partial shade by the more spectacular developments in the field of nuclear power.

Brook Motors and Dewhurst

The ordinary shares of Brook Motors and of Dewhurst & Partners, both of which produced last week their annual results, share the now uncommon distinction of standing around their best quotations of the year. In each case the price has been sustained by the expectation of such good figures, in respect of the twelve months ended last September, as have now materialized. After the news the quotation for Brook Motors 10s shares was put up to 47s. With the dividend raised to 25 per cent, the yield now works out at a little under 5½ per cent. A similar return is shown by Dewhurst & Partner 2s shares at 11s, on the basis of the dividend as increased from 24 to 30 per cent.

In the case of Dewhurst & Partner, a larger distribution for the past year had been indicated earlier by the raising of the interim dividend. The increase is shown by the preliminary profits statement to be accommodated comfortably by an expansion of over 40 per cent in the net profit. This reached £105,000 after tax, which is more than three times the net amount of the dividend payment. The net profit, after tax, of £239,000 reported

The Week's Price Changes

Company or Board	Nom. Value	Middle price 28th Nov.	Week's Rise or Fall]	Dividend Previous	Dividend Last	Yield %	1955 Highest	1955 Lowest
Gilt-edged Stocks						£ s d		
Brit. Elec. 1968/73	100	80½	+1	3	3	3 14 6	94⅜	76½
Brit. Elec. 1974/77	100	79⅛	+1	3	3	3 15 6	93⅛	75½
Brit. Elec. 1976/79	100	83½		3½	3½	4 3 9	98⅜	80½
Brit. Elec. 1974/79	100	95½		4¼	4¼	4 9 0	109	90½
Overseas Electric Supply								
Calcutta Elec.	£1	20/9		6†	6†	5 15 9	22/6	20/9
East African Power	£1	21/3		7	7	6 11 9	24/6	19/9
Nigerian Elec.	£1	21/6		10	10	9 6 0	27/-	21/-
Palestine Elec. "A"	£1	21/-		Nil	Nil	Nil	22/9	21/-
Perak Hydro-Elec.	£1	18/-		10	10	—	22/3	17/9
Equipment and Manufacturing								
Aberdare Cables	5/-	12/6		12½	17½	—	14/6	11/-
Aerialite	1/-	6/-		88⅜	45*	7 10 0	6/7	5/3
Allen, W. H.	£1	74/6		20	20	5 7 6	83/9	74/6
Aron Elec. Ord.	£1	55/6		15	15	5 8 0	63/9	55/6
Assoc. Elec. Ord.	£1	79/6	+2/-	11¼	14	3 10 3	96/-	62/6
Automatic Tel. & El.	£1	61/3		15	15*	4 18 0	79/6	60/-
Babcock & Wilcox	£1	77/9	+1/-	12*	15	3 17 3	98/-	68/6
Baldwin, H.	2/-	5/-		20	20	8 0 0	5/6	4/4
Bakelite	10/-	33/-		12½	16	4 17 0	34/6	27/-
British Aluminium	£1	48/9	+1/3	10	12	4 18 6	58/-	35/3
B.I. Callender's	£1	48/6	−6d	10	12½‡	5 3 0	55/3	44/9
B.I. Callender's 6% Pref. ...	£1	23/6		6	6	5 2 2	26/6	21/9
British Thermostat	5/-	31/3	+1/3	27½	27½	4 8 0	35/-	22/6
British Vac. Cleaner	5/-	8/3	+6d	25	30	—	10/-	6/6
Brook Motors	10/-	47/-	+2/-	20	25	5 6 6	47/-	39/9
Brush Ord.	5/-	7/6		6	10	6 13 3	9/6	7/6
Bulgin, A. F.	1/-	7/-	+3d	30	45	6 8 6	8/-	4/-
Burco Dean	5/-	13/-		—	—	—	17/3	12/-
Chloride El. Storage	£1	66/3		12½	17½	5 5 9	77/6	58/6
Clarke Chapman	£1	95/-		20	20*	4 4 3	102/6	68/9
Cole, E. K....	5/-	20/3		27½	17½*	4 6 6	25/6	18/3
Cossor, A. C.	5/-	9/-		10	15	8 6 8	14/-	8/9
Crabtree	10/-	28/6		20	20	7 0 3	34/6	27/6
Crompton Parkinson Ord. ...	5/-	15/-	−1/-	20	16*	5 6 8	19/9	15/-
De La Rue	5/-	20/-¼		20	30	7 10 0	26/-	17/-
Decca	4/-	41/3	+2/6	35	56¼*	—	48/9	31/-
Desoutter	5/-	31/3		20	25	4 0 0	35/-	25/6
Dewhurst	2/-	11/-		24	30	5 9 0	11/3	7/3
Dictograph Tel.	2/-	7/3		20	20	5 10 3	9/3	6/6
Dubilier Condenser	1/-	4/6		25	25*	5 11 0	5/7	3/1
E.M.I.	10/-	25/9	−3d	10	15	5 16 6	37/-	25/3
Electrical Components	5/-	15/-	+1/3	20	25	8 6 8	21/3	13/9
Elec. Construction	£1	28/9		15	8½*	5 18 3	41/3	28/9
Enfield Cable Ord.	£1	19/-	+3d	Nil	Nil	Nil	25/3	18/6
English Electric	£1	62/6	+1/-	10	12½	4 0 0	86/9	54/3
English Electric 3½% Pref. ...	£1	14/6		3½	3½	5 3 6	16/9	14/-
Ericsson Tel.	5/-	42/6	+3/6	25†	25*†	2 18 9†	46/6	29/-
Ever Ready	5/-	33/-		40	35*	5 6 1	38/-	22/3
Falk Stadelmann	£1	46/3		15	17½	7 11 3	52/6	42/-
G.E.C. Ord.	£1	62/6	+1/-	12½	14	4 9 6	80/3	51/3
G.E.C. 6½% Pref.	£1	24/9		6½	6½	5 5 0	28/4	23/6
General Cables	5/-	16/3		30	30	9 4 6	17/-	15/-
Greenwood & Batley	£1	47/6		17½	17½	7 7 4	57/6	47/6
Hackbridge Cable	5/-	22/9	−6d	20	25	5 10 0	23/3	14/-
Hackbridge & Hewittic	5/-	20/-	+6d	25	30	—	24/9	17/-
Hall Tel. Acc.	10/-	31/6	−6d	10	10	3 3 6	32/-	11/-
Heatrae	2/-	5/-		12½	15	6 0 0	5/9	4/3
Henley's	10/-	16/9		10½	10½	6 5 6	21/3	15/9
Holophane...	5/-	18/9		25	30	—	19/9	16/-

* After scrip issue. † Free of income tax. ‡ Dividend forecast.

The above quotations are based upon middle prices in the Stock Exchange Daily Official List.

by Brook Motors is a third more than the previous year's figure, and provides almost threefold cover for the higher dividend rate. The results bear out the implications of last year's annual report, which spoke of continuously increasing demands for the company's equipment.

Coming Issues

Letters are due to go out on 9th December from Pye, Ltd., offering new "A" shares to the deferred stockholders at a price of 12s 6d. The issue will raise about £600,000 fresh capital. With the existing "A" deferred shares standing at 21s 3d the value of the rights works out at approximately 9d per share. Cable & Wireless announce that official approval has now been given to the issue of 550,000 new £1 ordinary shares, which are to be offered to stockholders at 20s in due course. Both Pye and Cable & Wireless stocks have remained firm.

in Electrical Investments

Company or Board	Nom. Value	Middle price 28th Nov.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1955 Highest	1955 Lowest
Equipment and Manufacturing—continued						£ s d		
Hoover	5/-	39/-	+1/-	45	70	8 19 6	52/6	35/6
I.C.I.	£1	46/6	−6d	15	10*	4 6 0	61/9	38/3
Intl. Combustion	5/-	18/-		20	25	—	24/6	16/-
Johnson & Phillips	£1	43/3	−6d.	15	15	6 18 9	52/6	39/6
Lancashire Dynamo	£1	44/6		14	15	—	56/5	37/3
Laurence, Scott	5/-	16/3		20	12½*	3 17 0	19/6	14/6
Lister, R. A.	£1	28/9		12	9·3*	6 9 0	40/-	28/9
London Elec. Wire	£1	50/9		10	12½	4 18 6	61/3	50/6
Lucas, J.	£1	40/-		7½	7½	3 15 0	56/6	38/9
Marryat & Scott	2/-	10/3		25	30	5 17 0	13/-	9/6
Mather & Platt	£1	60/9		15	13·4*	—	75/-	48/-
Metal Industries	£1	25/-		9	9	7 4 0	38/-	25/-
Midland Elec. Mfg.	£1	50/-		15	10*	4 0 0	55/-	44/-
Morphy-Richards	4/-	27/9	−6d	35	50	7 4 3	35/-	27/-
Murex	£1	65/9	+3/6	15	20	6 1 9	66/-	49/3
Newman Ind.	2/-	2/9		10	10	7 5 6	3/6	2/4
Oldham & Son	1/-	3/-		17½	20	—	3/6	2/1
Parnall (Yate)	5/-	8/6		8	14	8 4 9	13/2	7/3
Parsons, C. A.	£1	77/6	+3/9	7½	10	2 11 6	100/-	56/-
Plessey	10/-	76/3	+2/6	20	27½	3 12 3	89/-	55/-
Pye Deferred	5/-	21/3		20	12½*	2 18 9	32/9	14/3
Revo	10/-	13/-		9	9	6 18 6	15/6	12/6
Reyrolle	£1	95/-		13⅜	15	3 3 3	127/6	89/-
Rheostatic	4/-	12/3		20	22½	—	14/3	9/3
Richardsons Westgarth	5/-	16/-		15	16⅔	5 4 3	19/-	11/-
Scottish Cables	4/-	16/9		27½	27½	6 11 3	22/6	16/3
Smith (England), S.	4/-	14/6	−3d	17½	17½	4 16 6	20/-	14/9
Southern Areas	£1	30/6		7½	10	6 11 3	38/-	27/6
Strand Elec.	5/-	8/9	+6d	17½	15*	8 11 6	13/3	7/6
Sturtevant	5/-	29/6	−6d	18·9	14·4†*	2 8 6†	35/9	21/-
Sun Elec.	£1	35/-		15	20	—	35/-	33/9
Switchgear & Cowans	5/-	16/3	+1/3	10	20	6 3 0	17/-	11/-
Taylor Tunnicliff	5/-	13/9		12½	15	5 9 0	16/3	11/3
T.C.C.	10/-	43/9		30	25*	5 14 3	53/9	41/-
T.C. & M.	£1	30/-	+6d	8½	8½	5 13 3	40/9	29/3
Telephone Mfg.	5/-	8/3		10	10	6 1 3	11/6	7/9
Thorn Elec.	5/-	21/3		20	15*	3 10 6	33/-	13/9
Thornycroft	£1	45/-		15	15*	6 13 3	47/6	34/6
Tube Investments	£1	57/6	+2/6	22½	14*‡	4 17 3	60/-	55/-
Vactric	5/-	16/3		10	15*	4 12 3	22/-	12/-
Veritys	5/-	9/9		12½	12½	6 8 3	12/2	7/-
Walsall Conduits	4/-	14/-		70	70	—	17/3	12/-
Ward & Goldstone	5/-	35/9	+9d	50	30*	4 4 0	45/-	32/6
Watford	2/-	7/-		22½	25	—	8/9	6/3
Westinghouse Brake	£1	86/3		16	18	4 3 6	110/-	82/-
West, Allen	5/-	13/-	+3d	17½	15*	5 15 6	16/6	8/-
Wolf Electric	5/-	22/-		17½	20	4 11 0	22/-	16/1
Trusts, Transport and Communications								
Anglo-Am. Tel.:								
A. Ord.	100	72½		6	6	8 5 6	88	67½
Ord.	100	45		3¾	3¾	8 6 8	54½	45
Anglo-Portuguese	£1	21/-		8	8	7 5 6	27/-	21/-
Brit. Elec. Traction:								
Def. Ord.	5/-	19/-		50	22½*	5 18 6	24/3	19/-
Cable & Wireless:								
Ord.	£1	42/6	+1/3	9	10	4 14 3	54/-	39/6
4% Loan	100	92½		4	4	4 6 6	100	92
Calcutta Trams	£1	26/9	+6d	6†	7½†	5 12 3†	26/9	20/-
Cape Elec. Trams.	£1	18/9		5½	7½	8 0 0	19/6	16/6
Marconi Marine	£1	31/3		10	10	6 8 0	41/3	31/3
Oriental Tel. Ord.	1/-	79/6		16	—	—	102/6	72/6
Telephone Rentals	5/-	11/3		10	12½	5 11 0	13/6	9/6

Six Times Covered

Investors have become more circumspect lately in their attitude towards shares showing a low return on the basis of current distributions. They are still ready enough to make exceptions, however, in strong and promising situations, and especially in cases where the rate of a dividend is covered heavily by the net earnings of the company concerned. Earlier this month the Plessey Company's annual results disclosed a dividend involving the distribution of less than one-sixth of the surplus available for payments and reserves. Now the J. Lucas full accounts confirm that here is another instance of a dividend with six-fold earnings cover. Both companies' shares are well supported on a yield basis of about 3¾ per cent, which is 1½ per cent below the average return from leading industrials.

Lucas Report

Since the publication of the report, J. Lucas (Industries) £1 shares have picked up most of the setback caused earlier by the decision to make no change in the ordinary dividend rate, which remains at a very conservative 7½ per cent. Points to attract notice in the report included the indication that the group's turnover had grown to about £88 million, and the statement that only the substantial increase in output enabled the company to get through the past year without large price increases. The motor industry remains the main source of the group's earnings, and Lucas have in hand a programme of expansion designed to meet the increasing demands.

Stock on Offer

Anglo-Portuguese Telephone new £1 ordinary shares have been available (free of transfer stamp) at a premium of about 1s 9d on the issue price of 20s; the yield is 7·3 per cent, assuming the maintenance of the regular 8 per cent dividends. The same company's 6 per cent preference shares are on offer at par. In the lists of preference shares offered recently in fair numbers, yields of 5 to 5½ per cent with sound security are freely available. In this range are, for instance, the 5½ per cent preference shares of B.I.C.C. at 21s 6d, Ferranti at 20s 6d, Lancashire Dynamo at 20s 9d, and the 5 per cents of Crabtree Electrical at 18s 3d. Among debenture stocks is the recently issued Kenya Power 5½ per cent at 96 (free of stamp), yielding nearly 5¾ per cent.

REPORTS and DIVIDENDS

Ferranti, Ltd.—In a circular to the 7 per cent cumulative preference and ordinary stockholders, the directors state that at the present time the amount which the directors may borrow is limited to £5,000,000 and this figure includes moneys borrowed by subsidiary companies. The continued expansion of the activities of the group and the consequent increased requirements for working capital make heavy demands upon the company's resources and the directors anticipate that in the current financial year the borrowing powers will be fully employed, and it is apparent that further amounts in respect of working capital will have to be provided. The directors are, however, of the opinion that it would not be in the best interests of the company to raise additional capital on a permanent basis under present conditions. They therefore ask for stockholders' approval to an increase in the present overall limit on borrowings. They propose that it should be the greater of the sum of £7,000,000 or the amount of the paid-up share capital and reserves and surpluses. On the basis of the balance sheet as at 31st March, 1955, the limit of £7,000,000 would operate. An extraordinary meeting to consider the proposals will be held on 15th December.

Associated Electrical Industries, Ltd., has disposed of its holding of 834,697 shares in Westland Aircraft to Helbert Wagg & Co., who have placed the shares with institutional investors. The sale, it is stated, has taken place in accordance with the policy of A.E.I., which is not to hold permanently shares in companies outside its normal activities.

A.E.I.'s offer to acquire the ordinary share capital of the Hill Top Foundry Co., Ltd., has been accepted by holders of more than 90 per cent of the ordinary shares.

Veritys, Ltd.—At a requisitioned meeting held in London on 22nd November the resolutions to remove from office Mr. H. B. T. Wilde and Mr. A. W. Hiley, and to appoint Mr. P. E. C. Merryfield and Mr. J. A. Robertson were not proceeded with. It was agreed that Messrs. Wilde and Hiley should remain on the board and that Messrs. Merryfield and Robertson should be co-opted as additional directors.

Waygood-Otis, Ltd., proposes to increase its capital to £725,000 by capitalizing £435,000 from capital revenue and a part balance of profit and loss, to be applied in paying up an additional 435,000 ordinary shares of £1 each which will be issued to ordinary holders free in the ratio of three new shares for each two shares held. The new shares will rank equally with the existing ordinary capital but will not participate in the interim dividend to be declared on or before 18th January next on the present capital. Treasury consent has been obtained to the issue.

Pye, Ltd., is making a rights issue to raise approximately £600,000. Deferred ordinary and "A" deferred ordinary stockholders will have the right to subscribe for 1,008,075 5s "A" deferred ordinary shares at a price of 12s 6d per share in the proportion of one for every ten 5s units held. Consent of the Capital Issues Committee has been obtained and the issue is being underwritten by W. Greenwell & Co.

Brook Motors, Ltd.—The consolidated profit for the year to 30th September last is £509,545, as compared with £423,825 for the preceding year. From the profit is deducted £270,247 for taxation. It is proposed to pay a final dividend of 20 per cent, making 25 per cent for the year. For the previous year an interim dividend of 5 per cent was paid on 998,693 ordinary shares, and a final dividend of 15 per cent on 1,141,364 shares.

G. D. Peters & Co., Ltd., have informed shareholders that an approach has been made as a result of which an offer may be made for the shares of the company early in the New Year at a price which should represent a value somewhat in excess of present market value. Shareholders will be advised as soon as the directors are in a position to issue further information.

Cable & Wireless (Holding), Ltd., announces that the consent of the Capital Issues Committee has been given to the issue of 550,000 ordinary shares of £1 each.

Lisbon Electric Tramways, Ltd., are paying an interim dividend of 2½ per cent, tax free (unchanged).

Worthington-Simpson, Ltd., have declared an interim dividend of 10 per cent (same) on increased capital.

The Hackbridge & Hewittic Electric Co., Ltd., has declared an interim dividend of 6 per cent (against 7½ per cent) on larger capital.

Tube Investments, Ltd.—It is reported that over 99 per cent of the rights offer of 7,247,431 £1 ordinary shares was taken up by stockholders.

Efco, Ltd., is paying an interim dividend of 2¼ per cent (against 4½ per cent) on doubled capital.

New Companies

Fielden Research, Ltd.—Registered 15th November. Capital £1,000. To carry out scientific researches, investigations and experimental work in particular in connection with electronics, electromotive power, intercommunication, telecommunication, instrumentation, nuclear physics, atomic power and the like, etc. J. E. Fielden is permanent director. Regd. office: Paston Road, Wythenshawe, Manchester, 22.

Holland Insulations (Electrical), Ltd.—Registered 1st November. Capital £100. Electrical and general engineers, manufacturers of and dealers in electrical insulations, insulating materials, etc. Directors: H. Cunliffe, W. Holland and E. Isles. Regd. office: 22, Cumberland Street, Manchester, 3.

Northern Phonographic Co., Ltd.—Registered 3rd November. Capital £1,500. Electrical and electronic engineers and contractors, manufacturers of and dealers in electrical, radio and television apparatus, etc. Directors: J. Lonsdale, R. Chappelow and J. E. Walker. Regd. office: Hawthorn House, Nutting Grove Terrace, Old Farnley, near Leeds.

Increases of Capital

Besson & Robinson, Ltd.—Increased by £9,000, in £1 ordinary shares, beyond the registered capital of £1,000.

Standard Insulator Co., Ltd.—Increased by £20,000, in £1 ordinary shares, beyond the registered capital of £20,000.

London Fan & Motor Co., Ltd.—Increased by £8,000, in £1 ordinary shares, beyond the registered capital of £13,000.

Strand Electric Holdings, Ltd.—Increased by £57,500, in 5s ordinary shares, beyond the registered capital of £115,000.

Bankruptcies

F. Kent, 397, High Street, Lincoln, trading as Lincoln Factoring Co., electrical wholesaler.—Receiving order made 15th November on debtor's own petition. Public examination 12th January at the Guildhall, Stonebow, Lincoln.

D. A. Wadsworth, 3, Kelvin Court, Chiswick, Middx, electrician.—Application for discharge to be heard on 20th January at the Court House, Half Acre, Brentford, Middx.

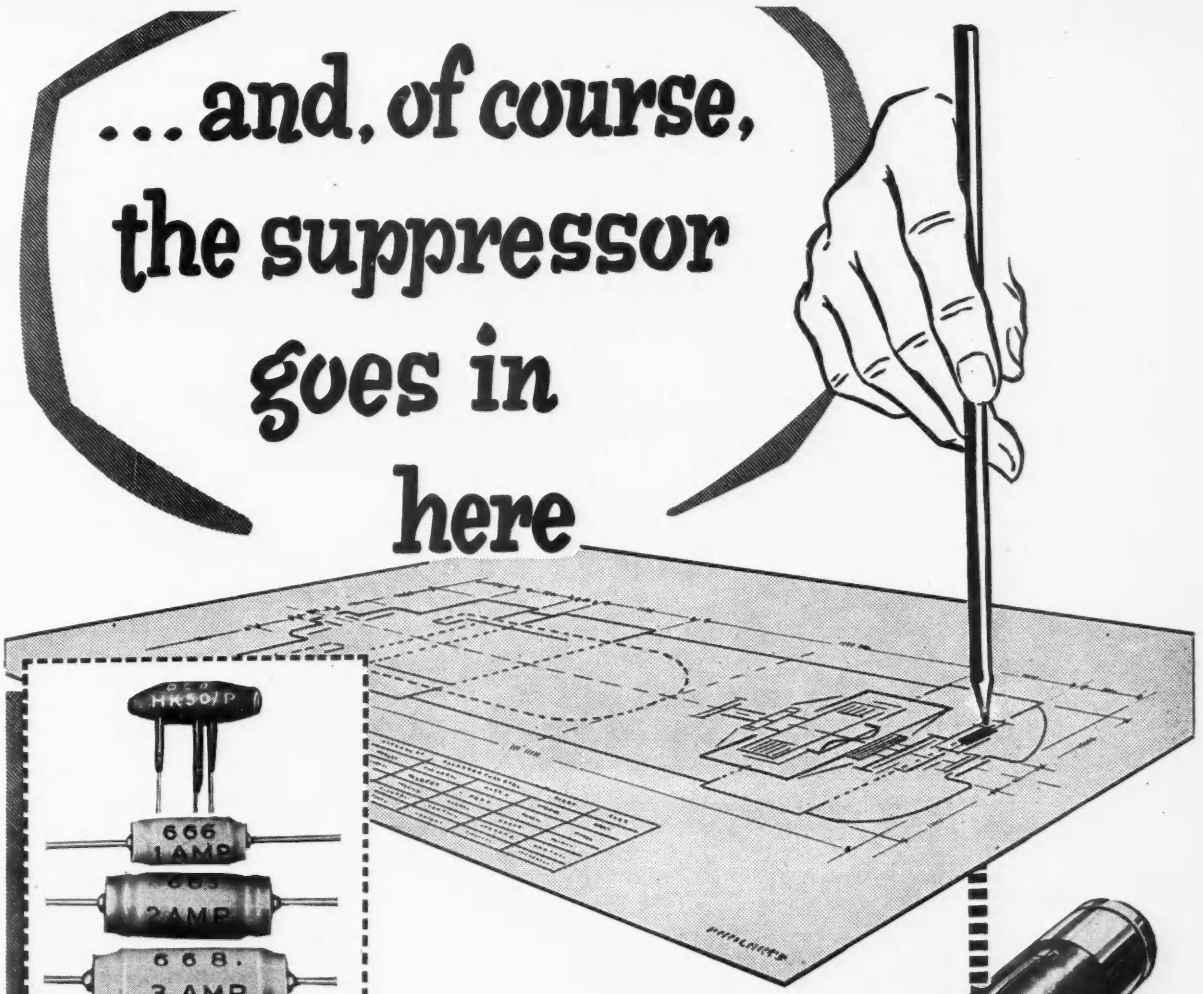
W. O. Curry, 17, Kent Close, Bexhill-on-Sea, previously carrying on business as an electrical contractor at 1, Tynevale Terrace, Lemington-on-Tyne, now electrician.—Trustee, Mr. J. S. Bradley-Hole, 7, Old Steine, Brighton, 1, appointed 14th November.

W. R. Eagle, lately carrying on business at 10, Houghton Chambers, 1, Houghton Place, Liverpool, electrical contractor.—Trustee, Mr. E. S. Browne, 41, North John Street, Liverpool, 2, released 9th November.

Liquidation

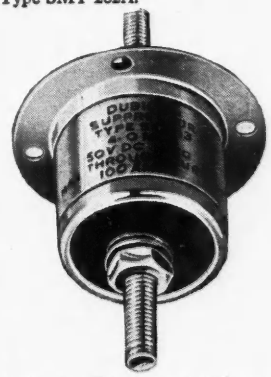
Lockwood & Son, Ltd., electrical engineers and contractors.—Winding up. Liquidator, Mr. W. L. Hand, Colmore House, 21, Waterloo Street, Birmingham, 2, appointed 15th November. Particulars of claims to the liquidator by 31st December.

...and, of course, the suppressor goes in here

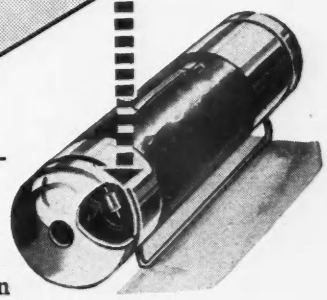


Television Interference suppressor kit for all domestic appliances.

Radio Interference suppressor Type SPT 202. Fully tropicalized version Type SMT 202A.



Radio & Television interference suppressor for large motors & generators. Types SBN & SBC.



It cannot be too strongly emphasized that the right time to consider the fitting of interference suppressors is at the drawing board stage. Failure to allow for the suppressor at this stage may result in production hold ups, and a product in which the external appearance has been spoilt due to the addition of a suppressor as an afterthought. It may even necessitate the use of non-standard suppressors entailing protracted delivery.

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Abolition of Meter Rents

Some 100,000 domestic and business users of electricity will pay less as a result of the South Eastern Electricity Board's decision, announced last week, to abolish the remaining meter rents for credit supplies. The decision, recommended by the Consultative Council, comes into effect from the end of the first quarter in 1956 and will cost the Board £60,000 a year. Meter rents associated with domestic and business two-part tariffs were withdrawn some years ago. Now those charged to consumers taking supplies on the alternative flat rates are also to be abolished following standardization of flat rates.

Meter rents will continue to be charged for slot meters because of their higher capital, maintenance and meter reading costs, and also for meters specially installed at consumers' request.

South of Scotland Tariffs

In September last the South of Scotland Electricity Board published new standard block tariffs covering all classes of consumers, together with special tariffs for catering and off-peak supplies. At that time it was intimated that standard maximum demand tariffs for commercial and industrial consumers would be introduced at a later date. The Board has now published a new standard m.d. tariff for commercial and industrial purposes and from 1st January next this will replace the existing m.d. tariffs. The introduction of the new tariff will result in some consumers paying more and others less but the overall revenue will remain approximately the same as at present. The tariff, details of which are given in the accompanying table, is on a monthly maximum demand basis. It will form an alternative to the recently introduced general block tariff and will apply to both commercial and industrial consumers.

	High Voltage	Medium Voltage
Maximum Demand Charge		
(Per kW of maximum demand at unity power factor in each month)		
First 200 kW ...	12s 6d	13s 9d
Next 800 kW ...	11s 0d	12s 0d
Next 2,000 kW ...	10s 0d	11s 0d
Each additional kW ...	8s 9d	9s 6d
"Unit" Charge		
Each of first 200 kWh per kW of m.d. in that month	0.70d	0.73d
Next 200 kWh	0.62d	0.65d
Additional kWh	0·52d	0·55d
"Unit" charge adjustment per 1d variation in the price of fuel from 60s a ton	0·00065d	0·0007d

At present the "unit" rates of the demand tariffs in the east and in the west parts of the Board's District are adjusted in relation to variations in the cost of fuel at generating stations in the east and in the west, respectively. Under the new tariff, the average cost of fuel at generating stations in the District (excluding the new experimental station at Barony) will be used as the basis for adjustment. Consumers will benefit from the new coal clause rates, the adjustments as shown comparing with the existing variation factors of 0·0007d and 0·00075d.

Supply to Glasgow Estate

The South of Scotland Electricity Board has approved the fourth and final portion of a major distribution scheme for supplying electricity to the new Castlemilk housing estate being built by Glasgow Corporation. The estate, part of which is already occupied, will comprise some 8,400 houses and will include schools, churches and shopping facilities. When completed it will have a total population of over 30,000.

The cost of supplying electricity to the estate amounts to over £413,000 and the work to be carried out by the Electricity Board includes the construction of 21 substations, 21 transformers with a total capacity of 11,000 kVA, and the laying of 52 miles of underground cables.

Following a recent decision of Glasgow Corporation, the tenants of the 826 houses in the final section of the estate will have freedom to choose either an electric or a gas cooker.

Procedure on Tariff Representations

In August last the Merseyside and North Wales Electricity Board informed the Consultative Council that, following the substantial increases in the price of coal, it had become necessary to raise electricity charges. Revised domestic and other tariffs were introduced as from 9th October and in the case of the domestic tariff these had the effect of increasing the running charge component from 0·85d to 1d. The Consultative Council accepted the need for an increase but felt that the Board's proposals were not equitable as between all consumers and suggested that the primary block charge of 4½d should be raised to 5d, the running charge being adjusted to 0·9d, or as a compromise that the primary charge should be increased to 4¾d and the running charge to 0·95d. It was pointed out that this would reduce the effect of the increases on those consumers with high consumptions, many of whom lived in all-electric council houses.

The Consultative Council was subsequently informed by the Board that it could not meet the Council's wishes. Accordingly, the Council decided to take the matter up with the Central Authority which on 17th October received a deputation. Later the Central Authority wrote stating that it did not think that the present tariffs disclosed a defect which would justify it in giving directions to bring about a further revision at the present juncture, but it accepted the validity of the view of the Council that the incidence of tariffs between different groups of consumers should be as fair as practicable and should be seen to be so. The letter went on to say that it was felt that the matter should be the subject of further consultation between the Board and the Council.

In a statement issued last week the Council says that it feels that an important issue arises. The Electricity Act provides for consultation between the Board and the Council on such matters as the variation of tariffs, and for the Council to make representations to the Central Authority, and to the Minister of Fuel and Power, if the Council is not satisfied with the Board's proposals. But the Central Authority is placed in a difficult position in having to give impartial consideration to the representations on tariffs that it has already agreed to.

Power for Rural Uganda

Electricity is to be made available over a wide area of Busoga, in the Eastern Province of Uganda, by the Uganda Electricity Board. The scheme will start at Jinja within a short distance of the Owen Falls hydro-electric scheme, and will stretch for many miles into the cotton-growing area of Busoga. Supplies of electricity will be made available to cotton ginneries, maize mills and oil mills, to coffee factories, small industries and hospitals, and to the headquarters of the local government.

Well over 1,000 premises in Busoga will benefit by the supply of electricity in the first few years and many more in later years. The scheme, which is estimated to cost £350,000, will require the construction of about 185 miles of h.v. lines and will take over five years to complete.

This Busoga electricity scheme is intended to be the forerunner of a number of comprehensive schemes for the distribution of electricity as widely as possible throughout Uganda.

Midlands Board's Policy on Capital Expenditure

Mr. W. S. Lewis, chairman of the Midlands Electricity Board, told the Area Consultative Council in Birmingham last week that connecting up new industrial supplies and new housing must come first, and therefore to achieve a 15 per cent cut in development expenditure non-operational building work would have to be banned and rural development spread over a greater period.

NEXT WEEK'S EVENTS

Organizers of electrical functions are advised to make use of the "Electrical Review" clearing house, Room 221, Dorset House, Stamford Street, London, S.E.1, to ascertain that proposed dates for their functions do not clash with others already arranged

Monday, 5th December

BIRMINGHAM.—James Watt Institute, Great Charles Street, 6 p.m. I.E.E. South Midland Centre. "Underwater Echo-Ranging," by Prof. D. G. Tucker. (Joint meeting with the Radio & Telecommunication and the Supply & Utilization Groups and the Birmingham Centre of the Institution of Post Office Electrical Engineers.)

ILFORD.—Angel Hotel, 8 p.m. A.S.E.E. North-East London Branch. "Commercial and Scientific Timekeeping," by D. Martin.

LEEDS.—Great Northern Hotel, 7.30 p.m. A.S.E.E. Leeds Branch. Films.

LIVERPOOL.—Electrical Engineering Department, Brownlow Hill, 6.30 p.m. I.E.E. Mersey & North Wales Centre. "Transistor Power Amplifiers," by R. A. Hilbourne and D. D. Jones.

LONDON.—Savoy Place, W.C.2, 5.30 p.m. I.E.E. informal meeting. Discussion on "Private Generation from the Point of View of the User," opened by A. N. Irens.

Caxton Hall, 7 p.m. E.P.E.A., London Technical Group. "Cathodic Protection," by J. H. Gosden.

NEWCASTLE-UPON-TYNE. — King's College, 6.15 p.m. I.E.E. North-Eastern Radio & Measurements Group. "Artificial Reverberation," by Dr. P. E. Axon, C. L. S. Gilford and D. E. L. Shorter.

County Hotel, Neville Street, 6 for 6.30 p.m. North East Electrical Club. "Lighthouse and Marine Lighting Engineering," by K. C. Sutton Jones.

SHEFFIELD.—Royal Victoria Station Hotel, 7.30 p.m. A.S.E.E. Sheffield Branch. "Motor Control Gear," by S. P. Maynard.

WORCESTER.—M.E.B. Social & Sports Club, Hilton Road, 7.30 p.m. I.E.E. South Midland Centre, Malvern & District Group. "The Service Engineer at an Atomic Energy Establishment," by W. E. Harris.

Monday, 5th December, to Friday, 9th December

LONDON.—Earls Court. Smithfield Show and Agricultural Machinery Exhibition.

Tuesday, 6th December

ARBORFIELD.—R.E.M.E. Training Centre, Bailleul Barracks, 7 p.m. I.E.E. London Graduates' & Students' Section, district meeting. Film evening.

CARDIFF.—Angel Hotel, Westgate Street, 7.30 p.m. A.S.E.E. South Wales Branch. Social evening.

EDINBURGH.—Carlton Hotel, North Bridge, 7 p.m. I.E.E. South-East Scotland Sub-Centre. "Electrical Energy from the Wind," by E. W. Golding.

25, Charlotte Square, 7 p.m. Incorporated Plant Engineers. "An Introduction to Atomic Energy," by J. A. Dixon.

ELTHAM. — Congregational Church Hall, Court Road, 8 p.m. A.S.E.E. South-East London Branch. "Diesel Engines."

GLASGOW.—Merchants' Hall, 6.30 p.m. Institute of Fuel, Scottish Section. "Nuclear Power Generation," by H. A. Davey. (Joint meeting with the National Industrial Fuel Efficiency Service.)

LEEDS.—1, Whitehall Road, 6.30 p.m. I.E.E. North Midland Centre. "Automatic Circuit Reclosers," by G. F. Peirson, A. H. Pollard and N. Care.

LONDON.—Savoy Place, W.C.2, 5.30 p.m. I.E.E. Measurement and Utilization Sections. 'The Instrumentation of a 14-Inch Experimental Rolling Mill," by S. S. Carlisle and G. W. Alderton. (Joint meeting.)

Holophane House, Elverton Street, Vincent Square, S.W.1, 7.30 p.m. A.S.E.E. West London Branch. "Industrial Lighting," by J. G. Holmes.

Manson House, Portland Place, 6.30 for 7 p.m. Society of Instrument Technology, Control Section. "Planning a Servo-Mechanisms Laboratory for Instructional Purposes," by E. B. Pearson.

Imperial Institute Road, S.W., 5.30 p.m. Imperial College. Inaugural lecture by Prof. A. Tustin on "The Next Ten Years in Electrical Engineering."

MANCHESTER. — Engineers' Club, Albert Square, 6.15 p.m. I.E.E. North-Western Centre. "TRIDAC—A Large Analogue Computing Machine," by Lt.-Cdr. F. J. R. Spearman, J. J. Gait, A. V. Hemingway and R. W. Hynes.

NEWPORT.—Y.M.C.A., Commercial Street, 7 p.m. Ministry of Works. "Powered Hand Tools," by A. F. Coare.

PETERBOROUGH.—White Lion Hotel, Church Street, 7.30 p.m. Institution of Production Engineers, North Midlands Region, Peterborough Section. "The Use of Plastics in Engineering," by B. E. Terry.

READING.—S.E.B. Showrooms, 3, Market Place, 7 p.m. A.S.E.E. Oxford, Reading & Districts Branch. "Automatic Temperature Control," by J. A. Taylor.

Wednesday, 7th December

ABERDEEN. — Robert Gordon's Technical College, 7.30 p.m. I.E.E. North Scotland Sub-Centre. "Design, Performance and Application of Miniature Circuit-Breakers," by H. W. Wolff and T. G. F. Atherton.

BATH.—Pump Room, 7 p.m. I.E.E. Bristol Graduates' & Students' Section. Students' Lecture: "Communication of Information—Human, Animal and Machine," by Dr. E. C. Cherry.

CARDIFF. — Llandaff Technical College, Western Avenue, 6.30 p.m. British Institution of Radio Engineers, South Wales Section. Discussion on "The Training of Radio Engineers," opened by Dr. W. J. Thomas, H. Roberts and A. J. Kenward.

EDINBURGH. — Y.M.C.A. Hall, 14, St. Andrews Street, 6.15 p.m. I.E.S. Edinburgh Centre. "Lighting of Parks and Gardens," by W. J. Vine.

GLASGOW.—39, Elmbank Crescent, 7 p.m. I.E.E. South-West Scotland Sub-Centre. "Electrical Energy from the Wind," by E. W. Golding.

HALIFAX.—Crown Hotel, Horton Street, 7.30 p.m. A.S.E.E. Halifax Branch. "Television," by H. B. Reeder.

HANLEY.—Victoria Hall, 7.30 p.m. I.E.E. North Staffordshire Sub-Centre. Faraday Lecture: "Coal Mining Electrically," by B. L. Metcalf.

HARRINGAY.—Queen's Head, 677, Green Lanes, 7.45 p.m. A.S.E.E. North London Branch. Films.

LIVERPOOL.—The Temple, Dale Street, 6 p.m. I.E.E. Mersey & North Wales Centre. "Vibration in Engineering," by E. B. Cole. (Joint meeting with the Liverpool Engineering Society.)

Chamber of Commerce, 1, Old Hall Street, 7 p.m. British Institution of Radio Engineers, Merseyside Section. "Radio Meteorology, with particular reference to the Radio Sonde," by K. Davin and F. C. Gibson.

LONDON.—Savoy Place, W.C.2, 5.30 p.m. I.E.E. Radio & Telecommunication Section. "Some Half-Tone Storage Tubes," by R. S. Webley, Dr. H. G. Lubczynski and J. A. Lodge.

I.E.E. London Graduates' & Students' Section. Visit to J. Lyons & Co., Ltd. (Electronic Office), Cadby Hall, W.14, at 2 p.m.

At the Institution of Civil Engineers, Great George Street, 5.30 p.m. Institute of Fuel, London Section. Melchett Lecture: "Power, Population and Productivity," by Dr. A. Parker.

4, Grosvenor Gardens, 6.30 p.m. Institute of Metals. Report on the Paris Low-Temperature Conference.

Grosvenor Hotel, S.W.1, 5.45 p.m. Engineers' Guild. Annual general meeting.

MANCHESTER. — Engineers' Club, Albert Square, 6.45 p.m. I.E.E. North-Western Radio & Telecommunication Group. Informal lecture on "The Recent Search for and Salvage of the Comet Aircraft near Elba," by Commander C. G. Forsberg, R.N., and G. G. MacNeice.

Engineers' Club, Albert Square, 7.30 p.m. A.S.E.E. Manchester Branch. Chairman's night.

MIDDLESBROUGH.—Cleveland Scientific & Technical Institute, 6.30 p.m. I.E.E. Tees-Side Sub-Centre. "Progress in Lamps and Lighting," by H. R. Ruff and R. V. Mills.

NEATH.—Town Hall, 7 p.m. Ministry of Works. "Powered Hand Tools," by A. F. Coare.

NEWCASTLE-UPON-TYNE. — King's College, College Road, 6.15 p.m. I.E.S. Newcastle Centre. "Road Vehicle Lighting," by J. H. Nelson.

PORTSMOUTH.—College of Technology Extension, 6.30 p.m. I.E.E. Southern Centre. "Maintenance Principles for Automatic Telephone Exchange Plant," by R. W. Palmer.

PRESTON. — 49a, Fishergate, 7.30 p.m. A.S.E.E. Preston Branch. "Relays and Instruments," by E. W. Semmens.

SWANSEA.—S. Wales Electricity Board's Demonstration Theatre, The Kingsway, 6.30 p.m. I.E.S. Swansea Group. "Report on the 1955 meeting of the International Commission on Illumination," by E. N. Lockyer.

WIMBLEDON.—Guild House, 32, Worple Road, 8.15 p.m. A.S.E.E. South-West London Branch. "Electronics in Industry," by Dr. L. E. C. Hughes.

Wednesday, 7th December, to Friday, 9th December

LONDON.—National Hall, Olympia. National Poultry Show.

Thursday, 8th December

CARDIFF.—Institute Buildings, Park Place, 6 p.m. South Wales Institute of Engineers. "Automatic Controls," by Dr. G. O. Forester.

S. Wales Electricity Board's Demonstration Theatre, The Hayes, 5.45 p.m. I.E.S. Cardiff Centre. "Report on the 1955 meeting of the International Commission on Illumination," by E. N. Lockyer.

CARMARTHEN.—Y.M.C.A., Furness House, St. Peter's Street, 7 p.m. Ministry of Works. "Powered Hand Tools," by A. F. Coare.

DUNDEE.—Queen's College, 7 p.m. I.E.E. North Scotland Sub-Centre. "Design, Performance and Application of Miniature Circuit-Breakers," by H. W. Wolff and T. G. F. Atherton.

GLASGOW.—39, Elmbank Crescent, 7 p.m. British Institution of Radio Engineers, Scottish Section. "Automatic Control of Machine Tools," by H. Ogden.

HULL.—Y.E.B., Ferensway, 7.15 p.m. I.E.E. North Midland Centre, district meeting. "Atomic Energy and Electricity Supply," by P. Mummery.

SOUTHAMPTON.—Polygon Hotel, 8 p.m. A.S.E.E. Southampton Branch. "Employers' Liability," by R. Hughes.

SWANSEA.—S. Wales Electricity Board Showrooms, The Kingsway, 6 p.m. I.E.E. West Wales (Swansea) Sub-Centre. "Thermionic Valves of Improved Quality for Government and Industrial Purposes," by E. G. Rowe, P. Welch and W. W. Wright.

(*Continued at foot of next page*)

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (3s 0d each including postage) will be obtainable after 4th January from the Patent Office, 25, Southampton Buildings, W.C.2.

1950

15396. Telefonaktiebolaget L. M. Ericsson.—Connecting devices comprising electron tubes. 20th June, 1950. (742852.)

1951

12713. Licentia Patent-Verwaltungs-Ges.—Semi-conductor system for the control of electric currents. 30th May, 1951. (742781.)

19829. Siemens-Schuckertwerke Akt.-Ges.—Electrically insulating liquid for electrical high tension devices. 22nd August, 1951. (742922.)

1952

952. Magnethermic Corporation.—Electric induction heater. 11th January, 1952. (742856.)

14252. General Electric Co., Ltd., and London, C. A.—Electric contactors. 5th June, 1953. (742926.)

14776. Electric & Musical Industries, Ltd.—Television receivers. 12th June, 1953. (742789.)

18552. English Electric Valve Co., Ltd.—Electric discharge devices having fragile envelopes partly filled with mercury. 2nd April, 1953. (742792.)

18657. General Electric Co., Ltd., Hill, R. T., and Saunders, E. F.—Manufacture of luminescent screens. 23rd July, 1953. (742987.)

24852. Compagnie des Machines Bull.—Impulse circulation electronic calculator. 3rd October, 1952. (742869.)

26696. Van Der Heem N.V.—Single-phase induction motors. 24th October, 1952. (742707.)

27731. British Thomson-Houston Co., Ltd.—Transmission system electromagnetic couplings. 4th November, 1953. (742708.)

29536. Westwood, W. C. C., and Westwood, H. W.—Magnetic separators. 18th May, 1954. Cognate application 2817, 30th January, 1953. (742932.)

32251. General Electric Co.—Automatic defrost control mechanism for refrigerators. 19th December, 1952. (742995.)

1953

707. Tesla Narodni Podnik.—Long distance telephone system with voice frequency signalling. 9th January, 1953. (742717.)

1218. General Electric Co.—Means for initiating the arc in mercury pool tubes. 15th January, 1953. (742877.)

1614. Standard Telephones & Cables, Ltd.—Sealing conductors through bulkheads. 4th December, 1953. (742801.)

3405. English Electric Co., Ltd.—Operating handles for electric switches. 5th February, 1954. (742880.) 3406. Closure for an electric switch cabinet. 5th February, 1954. (742881.)

3478. Marconi's Wireless Telegraph Co., Ltd.—Transmission lines of the co-axial type for use on high frequencies. 25th November, 1953. Addition to 706397. (742999.)

3673. Westinghouse Electric International Co.—Electroluminescent cells and luminescent materials therefor. 10th February, 1953. (743000.)

3685. Foster Transformers, Ltd., and Bagnall, R. I.—Arc welding transformers. 10th February, 1954. (742938.)

3746. World Radio, Ltd.—Press button tuning of radio receivers. 26th February, 1954. (742939.)

4714. Sunvic Controls, Ltd.—Electric snap-action switches. 27th January, 1954. (742883.)

5308. Reyrolle & Co., Ltd., A.—Transformer units for high voltage switchgear. 15th February, 1954. Cognate application 31588, 13th November, 1953. (743002.)

5348. Electric & Musical Industries, Ltd.—Thermally responsive electric switches. 24th February, 1954. (742724.)

5627. Napier & Son, Ltd., D.—Automatic control for electrical heater circuits. 18th February, 1954. (742726.)

5684. Electric & Musical Industries, Ltd.—Circuit arrangements embodying electron discharge devices. 25th February, 1954. (742941.)

5696. Murphy Radio, Ltd.—Automatic gain control in television apparatus. 26th February, 1954. (742942.)

5753. Husa, V., Kriz, J., Cerny, L., and Janos, L.—Electric circuit-breaker. 2nd March, 1953. (742727.)

6662. Simplex Electric Co., Ltd.—Electric cooking equipment. 4th March, 1954. (742730.)

7188. British Thomson-Houston Co., Ltd.—Magnetic amplifiers. 23rd February, 1954. (742886.)

9544. General Electric Co.—Waste food grinders. 8th April, 1953. (742946.)

10421. General Railway Signal Co.—Electromagnetic relays. 16th April, 1953. (743012.)

11132. Rola Celestion, Ltd.—Loudspeakers and like electro-acoustic transducers. 22nd April, 1954. (742889.)

11889. Elliott Bros. (London), Ltd.—Apparatus for measuring the magnitude and position of a standing wave in a waveguide section. 26th April, 1954. (742948.)

13243. Western Electric Co., Inc.—Travelling wave amplifiers. 12th May, 1953. (742739.)

17802. Philips Electrical Industries, Ltd.—Electromechanically tuned amplifiers. 26th June, 1953. (742897.)

18248. General Electric Co., Ltd., and Jones, A. F.—Telephone apparatus. 29th June, 1954. (743024.)

19502. British Thomson-Houston Co., Ltd.—Sealing strips for closure members. 14th July, 1954. (742899.)

19775. General Electric Co., Ltd., Patterson, K. G., and Small, G. F.—Electric switches. 12th July, 1954. (742749.)

20051. Philips Electrical Industries, Ltd.—Circuits for controlling the ignition of gas filled and/or vapour filled electric discharge tubes. 20th July, 1953. (742956.)

20362. General Electric Co.—Magnetron devices. 22nd July, 1953. (743030.)

23068. Etchells, Congdon & Muir, Ltd., and Bennett, A.—Door or gate locking mechanism for the shafts of electric lifts. 20th August, 1954. (742843.)

24802. Research Corporation.—Electrical precipitator. 8th September, 1953. (742846.)

24804. Bissell, A. G.—Thermostatic electric switches. 25th June, 1954. (743041.)

25610. Telefonaktiebolaget L. M. Ericsson.—Method for the production of an insulating layer of foam plastics on an electrical conductor. 16th September, 1953. (742760.)

27251. Philips Electrical Industries, Ltd.—Sawtooth oscillators employing transistors. 5th October, 1953. (742967.)

27544. Licentia Patent-Verwaltungs-Ges.—Electric fuse-elements with reduced cross section at one or more points. 7th October, 1953. (742968.)

28930. Western Electric Co., Inc.—Electrical amplifier devices and associated circuits. 20th October, 1953. (742824.)

30089. Radio Corporation of America.—Phase comparison circuit including a semiconducting device. 30th October, 1953. (742829.)

31556. General Electric Co.—Automatic washing machines. 13th November, 1953. (743047.)

32495. Fisher (Oldham), Ltd., H.—Washing machines. 27th October, 1954. (743049.)

32663. Fernseh Ges.—Television signal or image storage tubes. 25th November, 1953. (742776.)

33792. Standard Telephones & Cables, Ltd.—Submarine cable repeater housings. 4th December, 1953. (742830.) 34709. Electric carrier current communication systems. 14th December, 1953. (742977.)

35182. Schwarz, B.—Induction regulator control for a.c. commutator machines. 8th December, 1954. (742919.)

35318. Williams, R. E. J.—Electrical carbon contact assembly. 23rd July, 1954. (742979.)

36239. General Electric Co.—Methods of making vacuum insulated cabinets. 30th December, 1953. (742780.)

NEXT WEEK'S EVENTS *(Continued from preceding page)*

Thursday and Friday, 8th and 9th December

LONDON.—Caxton Hall. British Institute of Radiology. Annual Congress.

Friday, 9th December

BIRMINGHAM.—College of Technology, 53, Broad Street, 6.30 p.m. I.E.E. South Midland Education Discussion Circle. "The Training of Student Apprentices in the Electricity Supply Industry," by T. S. Hopkinson, A. G. F. Pallister and W. R. Warren.

Civic Centre, 6 p.m. I.E.E. South Midland Students' Section. Centre chairman's address, by H. S. Davidson.

Regent House, St. Philip's Place, Colmore Row, 7 p.m. Society of Instrument Technology, Midland Section. "Temperature Measurement in the Non-Ferrous Metal Industry," by D. Smith.

BRISTOL.—Grand Hotel, 7.30 p.m. A.S.E.E. Bristol & West of England Branch. "Relays and Automatic Control in Industry," by Dr. W. L. Stern.

LEICESTER.—College of Technology, 6.30 p.m. I.E.E. East Midland Centre. "Fuel Supplies of the Future," by D. Hicks. (Joint meeting with the Leicester Association of Engineers.)

LONDON.—Savoy Place, W.C.2, 6 p.m. I.E.E. Education Discussion Circle. Discussion on "Aids to Teaching the Subject of Windings in Rotating Machinery," opened by F. Stefani.

21, Albemarle Street, 9 p.m. Royal Institution of Great Britain. "The Discovery of Useful Electricity," by Sir Lawrence Bragg.

Pepys House, 14, Rochester Row, 7.30 p.m. Junior Institution of Engineers. Presidential address: "Dams," by G. M. Binnie.

Waldorf Hotel, Aldwych, 7 for 7.30 p.m. Institute of Metal Finishing. Annual dinner and dance.

NOTTINGHAM.—Daybrook House, Ribbledale Road, 7.30 p.m. Institution of Works Managers, Notts & Derby Branch. Annual ladies' evening, dinner and dance.

STOKE.—North Stafford Hotel, 8 p.m. A.S.E.E. Stoke & Crewe Branch. Films.

Saturday, 10th December

BIRMINGHAM.—Botanical Gardens. Institution of Production Engineers, Midlands Region, Birmingham Section. Christmas Party.

LONDON.—Park Lane Hotel, Piccadilly, W.1, 6.30 for 7 p.m. Association of Supervising Electrical Engineers. Ladies' night.

NOTTINGHAM.—A.S.E.E. Nottingham Branch. Visit to Ericsson Telephones, Ltd.

SHEFFIELD.—Grand Hotel. Incorporated Plant Engineers, Sheffield & District Branch. Dinner-dance.

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Australia.—17th January. Director Posts and Telegraphs, Melbourne. Ringing equipment. (E.S.B. 24753/55. Ten/16710.)*

Ayr.—County Council. Trunk road lighting equipment. (See this issue.)

Ballymoney.—16th December. Electrical installation at girls' primary school. A. Murdock, architect, 35, Main Street.

Cirencester.—15th December. U.D.C. Trunk road lighting equipment. (See this issue.)

Cork.—10th December. Vocational Education Committee. Electrical installation in the technical institute extension, Sharman Crawford Street, and the Gairm School, Wellington Road. F. H. M. Wain, consulting engineer, South Mall.

Dublin.—16th December. Corporation. L.v. switchboard for Stanley Street depot. Finance Department, City Hall.

Galashiels.—21st December. Corporation. Street lighting equipment. (See this issue.)

India.—8th December. Bombay Electric Supply and Transport Undertaking. Twenty-five 500 kVA distribution transformers. (E.S.B. 25034/55. Ten/16749.)* 12th January. H.v. and l.v. circuit-breakers. (E.S.B. 25033/55. Ten/16782.)*

Bombay Electricity Board. Turbo-alternator sets, boilers and ancillary equipment. Closing date for the receipt of tenders postponed to 26th December. (E.S.B. 19351/55. Ten/15590A.)*

20th December. Stores Purchase Committee, Government of Mysore, Bangalore. L.v. bushings. (E.S.B. 25491/55. Ten/16817.)*

20th January. Madhya Pradesh Electricity Board, Nagpur. Three 30,000 kW steam turbo-generators, condensers, feed heating and ancillary plant for Korba power station. (E.S.B. 25030/55. Ten/16786.)*

Leicestershire.—County Council. Firms wishing to be included in a selected list for electrical installations in secondary schools should apply to the county architect by 9th December. (See this issue.)

Marshland.—28th December. R.D.C. Electrical wiring of 26 pre-war houses at Walpole St. Peter, Wisbech. Surveyor, Council Offices, Alexandra Road, Wisbech, Cambs.

New Zealand.—23rd January. Stores Division, Posts and Telegraph Department, Wellington. Valve holders and valve screens. (E.S.B. 24964/55. Ten/16760.)*

20th March. State Hydro-Electric Department, Wellington. 500 MVA, 11 kV indoor switchgear for Bromley substation. (E.S.B. 25172/55. Ten/16783.)*

Pakistan.—7th December. Deputy Director General of Supply and Development, Chittagong. Heavy duty batteries. (E.S.B. 24988/55. Ten/16732.)*

15th December. State Bank of Pakistan, Karachi. Two escalators, six passenger lifts, two service lifts and one dumb waiter. (E.S.B. 25086/55. Ten/16774.)*

Ruislip-Northwood.—7th January. U.D.C. Electric lamps for one year from 1st April next. Surveyor, Council Offices, Northwood, Middlesex.

South Africa.—9th December. Transvaal Provincial Tender Board, Pretoria. Ten electrically operated Bowser type petrol pumps. (E.S.B. 25159/55. Ten/16753.)*

14th December. Stores and Buying Branch, City Treasurer's Department, Johannesburg. 100 150 MVA vertical draw-out switchboard cubicles. (E.S.B. 25395/55. Ten/16813.)*

14th December. Stores Department, South African Railways, Johannesburg. Insulated electric cable and wire. (E.S.B. 25016/55. Ten/16720.)* Telephone material, including staples, sirens and gummed tape. (E.S.B. 25255/55. Ten/16756.)* 23rd December. High speed circuit-breakers. (E.S.B. 25017/55. Ten/16750.)*

Southern Rhodesia. — 21st December. Bulawayo Electricity Department. H.v. cables. (E.S.B. 25186/55. Ten/16770.)*

Stranraer.—23rd December. Corporation. Trunk road lighting equipment. (See this issue.)

Syria.—3rd January. Director-General, Lattakia Port Company. Lighting standards and bulbs and materials. (E.S.B. 25184/55. Ten/16796.)*

Thailand.—26th December. State Railway, Bangkok. Railway workshop equipment, including portable electric lifting jacks, electric welders, centrifugal or reciprocating pumps, electric hoist and tube welding machine. (E.S.B. 24986/55. Ten/16758.)*

United States.—20th December. City Department of Lighting, Seattle. One 45,000/60,000 kVA, 3-phase power transformer. (E.S.B. 24748/55. Ten/16769.)*

Uruguay.—13th January. Usinas Electricas y los Telefonos del Estado, Montevideo. Telephone cords, tension regulators, and vacuum cleaners for telephonic equipment (re-issue of call for tenders). (E.S.B. 30201/54. Ten/12093A.)*

Wrexham.—31st December. R.D.C. Electrical wiring of 110 houses on several sites. T. Bowen, surveyor, Council Offices, Regent Street.

ORDERS PLACED

Fleetwood.—Corporation. Recommended. Electrical services in 50 houses at West View (£1,272).—Hobson & Scott.

Hereford.—City Council. Lighting (sodium) in Newmarket Street, Blusschool Street and Baths Street (£2,693).—North Midlands Engineering Co.

Middlesex.—West Middlesex Drainage Committee. Recommended. Six-cylinder dual-fuel diesel-electric generator for power station at Mogden works (£24,583).—Harland & Wolff.

Rochdale.—Corporation. Recommended. Electric lighting and power installations in technical school (£9,903) and Meenwood Junior and Infants' School (£1,105).—Henry Tattersall.

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Amersham. — Laboratories and offices; United Kingdom Atomic Energy Authority, 1, Richmond Terrace, London, S.W.1.

Basildon.—Factory for Thompson & Foster (Containers), Ltd., 50, Vyner Street, London, E.2; Thomas Bates & Son, Ltd., builders, Harold Wood, Romford.

Birmingham.—Large extensions to works (about £200,000) for Triplex Safety Glass Co.; W. J. Whittall & Son, Ltd., contractors, 132, Lancaster Street, Aston Cross, Birmingham, 4.

Brackley (Northants).—Houses at Croughton, Middleton Cheney and Farthinghoe; borough architect.

Brentwood.—Civic offices (£129,500) for U.D.C.; D. A. Dallas, surveyor, Council Offices, Ingrave Road.

Bristol.—Showrooms and offices, 11/13, Queens Road; Boots Pure Drug Co., Ltd., Station Street, Nottingham.

Chelmsford.—Four-storey extensions to Mid-Essex Technical College (£215,000); A. R. Dunnatt & Son, architects, 65a, Duke Street.

Consett.—Engineering factory, Castleside trading estate; R. B. Bolton & Co., Consett, Durham.

Coventry.—Showrooms and offices, Bishop Street; F. G. Plumb & Sons, Ltd., Chapel Street.

Civic theatre, shops and maisonnettes; Geo. Wimpey & Co., Ltd., builders, Chester Road, Castle Bromwich.

Darlington.—Bus station and repair garage at Feethams; United Bus Co.

Darwen.—Rebuilding premises at Belgrave Mill, Darwen, for G. & J. G. Potter, Ltd.; Frank Bradley, architect, 4, Wood Street, Bolton.

Glasgow.—Large factory on site at Garscadden; Goodyear Tyre & Rubber Co. (Great Britain), Ltd., Bushbury, Wolverhampton.

Hull.—Health centre, Bilton Grange estate; city architect.

Works and offices, Waverley Street; United Brass & Copper Works, Ltd., 25, Osborne Street.

London. — Multi-storey flats, Islington (£200,000); W. J. Simms, Sons & Cooke, Ltd., builders, 78, Mount Street, W.1.

Office block, Theobald's Road, Holborn; C. Miskin & Son, Ltd., builders, Romeland, St. Albans, Herts.

Reconstruction and development of St. Thomas's Hospital; W. Fowler Howitt, architect, 27, Paris Street, S.E.1.

Erection of wing at Crosby Hall, Cheyne Walk, Chelsea, for British Federation of University Women, Ltd., 17a, Kings Road, S.W.3; Carden & Godfrey, architects, 120, Chancery Lane, W.C.2.

Luton.—Factory for Electrolux, Ltd.; Barnes, Challen & Cross, architects, 96, Gloucester Place, London, W.1.

Manchester.—Extensions to factory, Cheetham, for Frederick Heywood Jr.; Moston Brick & Building Co., Ltd., Kenyon Lane, Collyhurst, Manchester.

Mansfield.—Extensions to factory at Corporation Road, for R. L. Jones & Co.; Kirk Bros. (Mansfield), Ltd., 112, George Street.

Nantwich.—Factory, Cumberland Street, for British Crepe, Ltd.; Cooper Bros. & John Clayton, Ltd., builders, Catherine Street, Macclesfield.

New Malden.—R.C. secondary modern school, Manor Drive North; Wilfrid C. Mangan, architect, 2, Ribblesdale Road, Preston, Lancs.

Reading.—Library and clinic, Tilehurst; Oscar Faber & Partners, heating and electrical consultants, 4, Verulam Buildings, Gray's Inn, London, W.C.1.

South Shields.—Office block, etc., Market Place, for Whitstone Properties, Ltd.; Cotton, Ballard and Blow, architects, Haymarket House, Newcastle-on-Tyne.

New premises for Sunderland and South Shields Water Co., Ltd.; G. T. Brown and Son, architects, Barclays Bank Chambers, Fawcett Street, Sunderland.

Additions to Ingham Infirmary for Newcastle Hospital Board, Benfield Road, Newcastle-on-Tyne (£30,000); P. H. Knighton, chief architect.

* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).